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***Central Eurasia:  
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# Science & Technology

## Central Eurasia: Life Sciences

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14 January 1992

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**Dose Accumulation From Internal Irradiation by Personnel of the Chernobyl Nuclear Power Plant and Persons Sent There on Temporary Duty in 1986-1987**

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[Article by V. I. Popov, O. A. Kochetkov, A. A. Molokanov, Yu. V. Abramov and L. G. Lapa, Biophysics Institute, USSR Ministry of Health, Moscow]

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[Text]

**Introduction**

A significant quantity of radionuclides entered the atmosphere from the damaged reactor of the Chernobyl Nuclear Power Plant as a result of the accident there. Data on the initial mass release and the quantitative characteristics of subsequent leakage of radioactive material from the reactor, which decreased gradually over time, were submitted in a report to the IAEA [International Atomic Energy Agency].<sup>1</sup> One of the factors of radioactive exposure (besides external irradiation by the cloud and fallout) was internal irradiation resulting from inhalation of radioactive aerosols from the accidental release and secondary aerosols originating from contaminated surfaces. Peroral uptake of radionuclides with foodstuffs was precluded both at the Chernobyl Nuclear Power Plant and in the 30-kilometer zone by organizing food services dispensing uncontaminated food.

This paper examines measurements of ambient air characteristics in the zone of the damaged reactor—ones such as the concentration of aerosols, their particle size distribution, their biological transportability and their radionuclide composition. It also gives the doses accumulated through internal irradiation as a result of uptake by inhalation. These doses were determined from actual measurements of uptake and from the concentrations of different radionuclides in the bodies of personnel of the Chernobyl Nuclear Power Plant and persons sent there on temporary duty.

**1. Characteristics of the Air Environment in the Zone of the Damaged Block**

The characteristics of contamination of the air environment—concentration, isotope and particle size composition of radioactive aerosols—were determined by taking samples on analytical aerosol filters and then measuring the samples, and by inertial separation of aerosol particles by means of a five-stage cascade impactor<sup>2</sup> with sorting diameters of 0.5, 1.5, 4.0, 8.5 and 16.5  $\mu$  at a nominal air flow rate of 3 m<sup>3</sup>/hr.

After separating particles into size fractions we measured the radioactivity and isotope composition of each fraction.

The activity of  $\alpha$ -emitting nuclides was measured by an SAS R-2 radiometer with regard for the coefficients of self-absorption of  $\alpha$ -particles in each fraction; after this, the measurements were repeated following preparation of the samples by radiochemical methods.<sup>3</sup> The nuclide composition of  $\alpha$ -emitters was determined on a spectrometer (Ortek, model 576) with a TA-21 silicon surface-barrier detector with a 450 mm<sup>2</sup> active surface area and a resolution of around 30 keV for the energy of  $\alpha$ -emission by <sup>241</sup>Am (5.486 MeV).

The concentration of  $\gamma$ -emitting isotopes in each fraction was determined by a relative method on a spectrometer with a coaxial germanium-lithium detector (Ortek) with a rated effectiveness of 1 Bq per sample for <sup>137</sup>Cs at a sample volume of 200 cm<sup>3</sup>. The measurement time was selected so as to ensure 20 percent error.

The concentration of <sup>90</sup>Sr in the samples was determined by a procedure of the State Committee for Hydrometeorology.<sup>4</sup> Radioactivity was measured with a low-background unit (Kanberra-2201) with a flow-through proportional gas counter (entrance window diameter 57 mm, thickness 80  $\mu$ /cm<sup>2</sup>). The precipitate to be analyzed was applied to aluminum trays with a diameter of 40 mm.

The biological transportability of particles was evaluated by dialysis in relation to a two-day concentration of the soluble fraction of isotopes in Ringer's solution. The method's sensitivity was 1 Bq per 0.01 ml solution, and measurement error did not exceed 30 percent.

Maximum permissible annual uptake (MPU) for a mixture of radionuclides was calculated on the basis of the basic dose limits stated in the publication NRB-76/87, but also with regard for aerosol particle size distribution and transportability, and recommendations of the ICRP [International Commission on Radiological Protection].<sup>5</sup> The proportion of deposited radioactivity in different divisions of the respiratory system was determined using the corresponding particle retention functions proposed in the ICRP's lung model.<sup>6</sup>

A log-normal function characterized by an active median aerodynamic diameter (AMAD) and a geometric deviation of  $\beta_g$  was used to describe the distribution of nuclide radioactivity in relation to aerosol particle size.

Permissible concentrations (PC<sub>A</sub>) were calculated on the basis of the maximum work time of permanent and temporary personnel—900 hours per year (in 1986) and 1,700 hours per year (in 1987). Note that in 1986 the actual work time in the zone of the damaged reactor and in buildings of the third and fourth blocks was significantly lower owing to restrictions accounting for the external irradiation dose.

According to measurements of the transportability of different nuclides carried out in May and August 1986 (Table 1.1), <sup>141</sup>Ce, <sup>144</sup>Ce, <sup>95</sup>Zr, <sup>95</sup>Nb, <sup>60</sup>Co and <sup>54</sup>Mn nuclides were found in insoluble form, transuranium elements (TUE's) were found in weakly soluble form, and <sup>90</sup>Sr, <sup>134</sup>Cs, <sup>137</sup>Cs and

$^{140}\text{La}$  were found in soluble form. At the time of the accident  $^{106}\text{Ru}$  was in insoluble form, most likely in the unoxidized

form (as a metal alloy). Later on,  $^{103}\text{Ru}$  and  $^{106}\text{Ru}$  were observed in air samples and in oxidized soluble form.

Table 1.1. Transportability of Aerosols, Percent

Nuclides	May 1986	August 1986
$^{103}\text{Ru}$	42 +/- 9	57 +/- 12
$^{106}\text{Ru}$	0.2	57 +/- 12
$^{144}\text{Ce}$	0	7.5 +/- 4
$^{141}\text{Ce}$	0	0
$^{125}\text{Sb}$	-	79 +/- 8
$^{134}\text{Cs}$	61 +/- 15	60 +/- 15
$^{137}\text{Cs}$	63 +/- 15	60 +/- 15
$^{95}\text{Zr}$	0	12 +/- 4
$^{95}\text{Nb}$	0	12 +/- 4
$^{54}\text{Mn}$	-	0
$^{140}\text{La}$	50 +/- 10	-
$^{220}\text{mAg}$	-	42 +/- 20
$^{60}\text{Co}$	-	0
$^{90}\text{Sr}$	20 +/- 2	20 +/- 2
$\alpha$ -Emitters	2 +/- 1	0.2-0.4

All plant spaces were divided into two groups to permit analysis of the experimental data on contamination of the air environment of the Chernobyl Nuclear Power Plant: group 1—spaces permanently occupied by personnel, control panel rooms, break rooms, hallways and other spaces where power plant and temporarily assigned personnel remained for the basic part of the work time (ambient air about the power plant can also be included in this group with regard for observed concentrations); group 2—undecontaminated spaces, when repairs and maintenance are carried out in them.

The characteristics of the air environment, determined at different times in group 1 and 2 spaces, are given in tables 1.2 and 1.3 for TUE's and for  $\gamma$ - and  $\beta$ -emitting nuclides respectively. It follows from these data that spaces in blocks I and II were characterized in June 1986 by a stable level of air contamination that varied insignificantly with respect to the mean, which did not exceed 0.25  $\text{PC}_A$ . Significant scatter of concentrations, with the means exceeding the  $\text{PC}_A$  by a factor of 2-4, was observed in August-September 1986 for group 2 spaces as well as for group 1 spaces in block III. The difference between the average concentrations in group 1 and group 2 spaces was within 1.5-3 orders of magnitude.

Table 1.2. Characteristics of TUE Aerosols in the Vicinity of the Damaged Block ( $x_{\text{ave}} \pm \Delta x$ ;  $p = 0.95$ )

Date	Concentration of Total $\alpha$ -Emitting Nuclides, $\text{Bq/m}^3$		Composition of $\alpha$ -Emitting Nuclides, %			$^{241}\text{Pu}$	AMAD, $\mu$	$\beta_g$	MPU, $\text{Bq/year}$	PC, $\text{Bq/m}^3$
	Group 1 Spaces	Group 2 Spaces	238, 239, $^{240}\text{Pu}$ + $^{241}\text{Am}$	$^{242}\text{Cm}$	$^{244}\text{Cm}$	238, 239, $^{240}\text{Pu}$ , Calculated as in [12]				
Jun-Jul 86	0.56 +/- 0.2*	..**	13 +/- 2	85 +/- 3	2.0 +/- 0.5	50	35 +/- 7	4 +/- 0.6	3700	2.8
Aug-Sep 86	4.8 +/- 3.7	7.8 +/- 5.5	12***	85***	3.0 <sup>(3)</sup>	50	25 +/- 13	3.8 +/- 0.4	3700	2.8
Jun-Jul 87	0.05 +/- 0.02	1.5 +/- 0.7	37***	56***	7.0 <sup>(3)</sup>	50	29 +/- 8	3.0 +/- 0.6	1600	0.64
Oct-Nov 87	0.02 +/- 0.01	..**	43 +/- 11	49 +/- 7	8 +/- 4	50	10 +/- 5	2.5 +/- 0.4	1300	0.52

\*Data pertain to block I and II spaces; the rest of the data pertain to spaces in blocks III and IV of the Chernobyl Nuclear Power Plant.

\*\*There were no spaces of this group at the time of the measurements.

\*\*\*The composition of  $\alpha$ -radiation was obtained by converting the experimental data for Nov-Oct 87.

**Table 1.3. Characteristics of Aerosols of  $\beta$ - and  $\gamma$ -Active Nuclides in the Vicinity of the Damaged Block**  
( $x_{ave} \pm \Delta x$ ;  $p = 0.95$ )

Date	Concentration of Total $\beta$ -Emitting Nuclides, $10^3$ Bq/m <sup>3</sup>		Isotope Composition of Radionuclides Making the Main Contribution to the MPU, %									AMAD, $\mu$	$\beta_g$	MPU, $10^6$ Bq/year	PC, Bq/m <sup>3</sup>
	Group 1 Spaces	Group 2 Spaces	<sup>141</sup> Ce	<sup>144</sup> Ce	<sup>103</sup> Ru	<sup>106</sup> Ru	<sup>95</sup> Zr	<sup>95</sup> Nb	<sup>134</sup> Cs	<sup>137</sup> Cs	<sup>90</sup> Sr				
Jun-Jul 86	0.44 +/- 0.2*	-**	10.5 +/- 2	14 +/- 6	10 +/- 3	11 +/- 5	23 +/- 5	23 +/- 5	2.5 +/- 1	5.0 +/- 2	1.0 +/- 0.5	35 +/- 10***	4.0 +/- 0.6	2.4	1.85
Aug-Sep 86	4.4 +/- 4	7 +/- 5	5.5 +/- 1	16 +/- 6	6 +/- 2	12 +/- 5	25 +/- 5	26 +/- 5	2.8 +/- 1	5.6 +/- 2	1.1 +/- 0.5	21 +/- 12***	3.0 +/- 0.5	2.4	1.85
Jun-Jul 87	0.04 +/- 0.02	1.0 +/- 0.8	-	28 +/- 4	-	25 +/- 3	2.2 +/- 1	3.0 +/- 1	10.6 +/- 3	29 +/- 6	2.3 +/- 1	25 +/- 8****	3 +/- 0.6	3.7	1.5
Oct-Nov 87	0.02 +/- 0.01	-**	-	28 +/- 4	-	25 +/- 3	1.3 +/- 0.5	1.7 +/- 0.7	11 +/- 3	33 +/- 6	2.6 +/- 1	10 +/- 5****	2.5 +/- 0.4	3.7	1.5

\*,\*\*See the notes for Table 1.2.

\*\*\*<sup>103</sup>Ru and <sup>106</sup>Ru isotopes were observed both as a large-particle aerosol fraction (its composition and distribution parameters are shown in the table) and as fine-particle aerosol (AMAD 0.5  $\mu$ ), the radioactivity of which in June-July 1986 was 15-10 percent of the total radioactivity of the large-particle fraction of  $\beta$ -aerosols. This quantity of fine-particle ruthenium aerosol causes a 10-fold reduction in the MPU $\beta$ .

\*\*\*\*<sup>134</sup>Cs, <sup>137</sup>Cs and <sup>106</sup>Ru nuclides were observed as two aerosol fractions: large-particle (AMAD = 10-25  $\mu$ ) and fine-particle (AMAD = 0.5  $\mu$ ); with the radioactivity of the fine-particle aerosol fraction of each nuclide being 11 +/- 5 percent of the radioactivity of the large-particle fraction in September-October 1987. This causes a 2-fold reduction of the MPU $\beta$ .

In 1987 the concentrations in group 1 spaces were an order of magnitude below permissible, they were around 2-3 PC<sub>A</sub> for group 2 spaces and TUE's, and they were less than 1 PC<sub>A</sub> in relation to other nuclides.

**Table 1.4. Calculated Values of Radioactive Aerosol Uptake in Proportion to MPU's for Personnel Working in Different Conditions Without Personal Protective Gear**

Year	Nuclide Group	Blocks I and II	Blocks III and IV	
		Group 1 Spaces	Group 1 Spaces	Group 2 Spaces
1986	$\alpha$	0.1-0.3	0.4-3.0	1.0-5.0
	$\beta$	0.1-0.3	0.2-4.0	1.0-6.0
1987	$\alpha$	-	0.04-0.2	1.0-5.0
	$\beta$	-	0.007-0.04	0.2-1.0

In all probability, inhalational uptake of aerosols might have occurred primarily as a result of the presence of people in group 1 spaces, where people often failed to use personal gear to protect their respiratory organs. Assuming that personal protective gear was absent (Table 1.4), it follows from calculated estimates of probable aerosol uptake that the uptake of radionuclides by people working in blocks I and II could not have exceeded 0.3 MPU on the average by as early as June 1986; however, in cases where people were present in group 1 and 2 spaces of blocks III and IV in 1986 and people were doing work in group 2 spaces in 1987

without personal protective gear, radionuclide uptake might have exceeded the 5 MPU value set by the standards for accidental exposure. It also follows from Table 1.4 that in 1986, TUE and  $\beta$ -active nuclide aerosols in spaces of blocks III and IV presented approximately the same danger from the standpoint of accumulation of the anticipated doses of internal irradiation, while in 1987 and in subsequent years TUE aerosols presented the main danger, with the contribution of  $\beta$ -active aerosols to the dose not exceeding 10-20 percent by as early as 1987.

## 2. Internal Irradiation Due to Inhalational Uptake of Radionuclides During the Accident

### 2.1. Estimation of Inhalational Uptake and of the Radionuclide Concentration in the Body

The actual uptake and concentration of nuclides in the body were determined on the basis of data from examinations conducted in a biophysical laboratory, in which the concentrations of TUE's and strontium isotopes in eliminated matter (urine, feces) and in nasal smears were measured, and on the basis of measurements of  $\gamma$ -emitting nuclides by a human radiation counter (SICH).

Modifications of known procedures of radiochemical analysis were used in the examinations at the biophysical laboratory [1]. In particular, the total concentration of TUE's in excreta was determined by concentrating them on precipitate consisting of phosphates of alkaline-earth elements, isolating bismuth phosphate in the precipitate,

and then conducting radiometry of  $\alpha$ -emissions in a solid scintillator layer (ZnS). The sensitivity of measuring TUE's at a radiometry time of one to two hours and in the presence of a background of approximately 0.15 pulses per minute is (with 30 percent error) 0.04 Bq (1 pCi) in daily urine and 0.06 Bq (1.7 pCi) in daily feces. The concentration of strontium isotopes in urine was determined by precipitation ( $^{89}\text{Sr}$ ) and by extraction ( $^{90}\text{Sr}$ ), followed by radiometry of a target containing solidified secondary extract. Sensitivity at a measurement time of one to two hours and a background of five to six pulses per minute is (30 percent error) around 0.7 Bq (20 pCi) in daily urine. The sensitivity limits are indicated for a confidence level of 95 percent.

The examinations were conducted in the biophysical laboratory from June 1986 to September 1987. Internal uptake of TUE's by temporarily assigned personnel (group K) was estimated from measurements of the radioactivity of  $\alpha$ -emissions in samples of feces. When examinations were made in the course of contact with radioactivity or in the days immediately following termination of such contact, an equilibrium state established itself by as early as one week after the beginning of uptake in the case of aerosols for which the AMAD is greater than or equal to  $10\ \mu$  (see Table 1.2). In the presence of this state (assuming that TUE uptake is uniform), the amount of radioactivity eliminated with feces was approximately equal to one-time uptake. Total uptake is defined as the product of the concentration of TUE's in daily feces and the time of contact. Uptake defined in this way was compared with MPU values at the moment of the measurements (see Table 1.2).

According to the results of biophysical examination of persons in group K in 1986 (127 individuals), maximum daily uptake (as per the  $3\sigma$  criterion) was 19 Bq which, assuming that work time in the zone was 900 hours, could result in maximum total uptake of around 1.7 kBq (46 nCi), or less than 0.5 MPU.

Uptake was also estimated by  $\alpha$ -radiometry of nasal smears. According to the results of examining 96 persons, average daily inhalational uptake did not exceed 2 MPU per day, which would result in uptake of not more than 1 MPU for the assumed time of work.

These estimates characterize the possible maximum uptake, inasmuch as the total work time for persons in group K was up to one month in most cases due to restrictions imposed on the basis of the external irradiation dose.

The average for the two methods of estimating TUE uptake is 0.8 MPU, and it agrees well with calculated data (see Table 1.4) for 1986. A value of 5-10 obtained in this case for the effective protection factor from using personal protective gear appears sufficiently realistic.

It should be noted that the group of temporarily assigned personnel examined in 1986 were employed in jobs presenting an elevated danger of inhalational uptake (work inside the station and in undecontaminated spaces

prior to start-up, work in the industrial area near blocks III and IV, removal of fuel rod fragments from the roof of block III, work at vehicle decontamination stations, and so on), with the wearing of gas masks mandatory during work.

According to the results of the biophysical examination conducted in 1987 (94 persons), maximum uptake did not exceed 0.2 MPU for associates of the Chernobyl Nuclear Power Plant and 0.06 MPU for associates of the Kombinat Production Association and for military servicemen, which is a little less than the maximum calculated estimates for 1,700 hours (see Table 1.4), assuming the same respiratory protective factor. It must be emphasized that when we take account of the actual working time in contact with contaminants, the median uptake based on the results of examinations at the biophysical laboratory was 20-30 times less than the maximum estimate (0.8 MPU and 0.2 MPU in 1986 and 1987 respectively).

These data show that the results of the examinations in the biophysical laboratory agree satisfactorily with calculated estimates of uptake of secondary TUE aerosols in connection with accident recovery operations in summer and fall 1986 and in 1987. At the same time these data reveal the need for constantly monitoring TUE uptake by persons working in blocks III and IV in the next few years.

TUE aerosol uptake was significantly greater among people who were in or near the station at the moment of the accident (group A). A relatively short period of inhalational uptake of primary aerosols from the reactors (in the first one to two weeks after the accident), followed by either complete or partial cessation of contact for different periods of time (evacuation, hospital examination, leave etc.), was typical of them. Uptake was estimated for this group by determining the concentration of TUE's in the body on the basis of radiometry of  $\alpha$ -radioactivity in daily urine samples.

A function for daily excretion of plutonium with urine obtained by Langham [6] and a function corresponding to it (accounting for excretion with feces as well) for retention of radioactivity in the body were used to determine radioactivity in the body. The possibility of using the latter function was confirmed by measurements taken from samples of sectioned material from persons killed by radiation sickness. Comparison of total systemic  $\alpha$ -radioactivity determined from measurements taken from sectioned material with radioactivity determined from measurements of urine samples from living individuals showed that the estimate arrived at using Langham's function is double the actual value.

The amount of  $\alpha$ -radioactivity in the body was determined for 199 persons (104 in 1986), with most of them having been examined not less than twice (Table 2.1). The average concentrations measured in 1986 and 1987 (130 and 59 Bq) agree well with each other, considering decay of  $^{242}\text{Cm}$ .



**Table 2.1. Distribution of the Concentration of TUE Radioactivity in the Body for Persons of Group A, According to Data From Examinations in 1986-1987**

Radioactivity of $\alpha$ -Emitters in the Body, Bq	<1.5	1.5-370	370-740	740-2500 (1986), 740-1300 (1987)
Number of persons with the given radioactivity concentration; percent of total is given in parentheses	1986, 28 (27)	56 (54)	16 (15)	4 (4)
	1987, 65 (68)	21 (22)	5 (5.3)	4 (4.2)

Of the persons examined in 1986-1987, 82 did not leave the city of Prip'yat at the moment of the accident and in the next two to three days (over half of them were professionals). Because they could be placed in the same category as the population at large in terms of the conditions they experienced, a possibility arises for assessing the concentration of TUE's separately for professionals and for the population at large. The average concentration of TUE's in the body, expressed in relation to the 120th day after the accident (the average measurement time in 1986), was found to be equal to 150 Bq for 117 professionals who had worked at the power plant in the first days after the accident. This was approximately 1.5 times more than for the conditional population group.

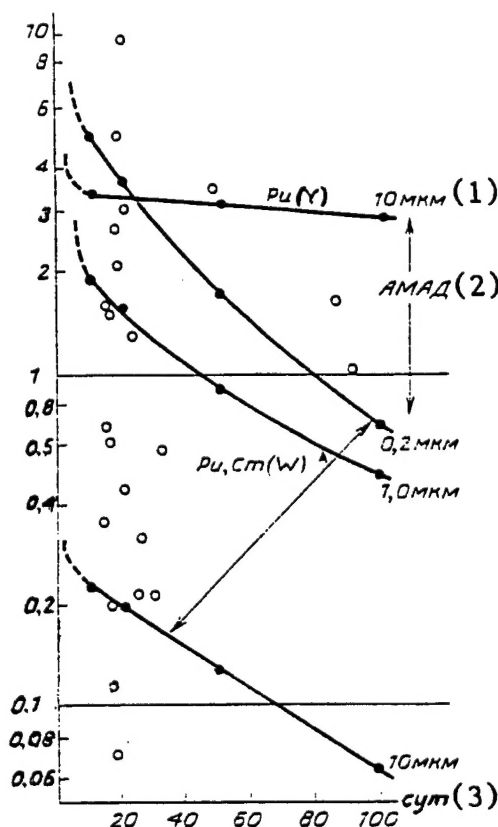
That this estimate is close to the real value is confirmed by the  $\alpha$ -radioactivity measured in sectioned material from persons killed by radiation sickness 15-30 days after the accident. The concentration of TUE's in the skeleton, liver and kidneys of most of them (22 persons) was within 1.5 and 1,400 Bq. Radioactivity was less than 1.5 Bq in another three persons, and around 14 kBq in one. Even with regard for this last exceptionally high concentration (explained by the individual's location at the moment of the explosion), the range of variation of the systemic concentration is close to that established for persons of group A. If we consider that those who died were in the most dangerous conditions for even a short time from the standpoint of inhalation of TUE aerosols—that is, near the damaged reactor and during the initial release, the obtained results (see Table 2.1) may be said to be plausible.

**Table 2.2. Retrieval of the Values of Inhalational Uptake of TUE's by Professionals**

AMAD, $\mu$	Uptake, kBq (pCi)	
	total TUE's less $^{241}\text{Pu}$	$^{241}\text{Pu}$
1	2.2 (60)	10 (280)
10	1.7 (47)	8.0 (220)

Considering the data on transportability of secondary TUE aerosols, we can assume that the transportability of primary aerosols was not worse than 2 percent, which allows us to place them in class W of the ICRP lung model. This assumption is confirmed by analysis of sectioned material. With regard for times of death, most

of the data concerning the relationship between  $\alpha$ -radioactivity in the lungs ( $Q_L$ ) and other tissues ( $Q_{RB}$ ) (see figure) are between the curves describing variations of function  $Q_L/Q_{RB}$  with respect to time for compounds of class W and for AMAD values of 1 and 10  $\mu$ , calculated for plutonium and curium (the function does not depend on uptake). In five out of 22 cases the TUE concentration in the lungs is somewhat elevated; however, this is explained most likely by disturbances of lung functions observed in the clinical pattern.



Key: 1. microns 2. AMAD 3. Days

**Change in the Ratio of Radioactivity in Lungs and in Other Tissues Over Time Following One-Time Uptake of Plutonium and Curium Aerosols of Different Particle Size Distributions and Transportabilities: Circles—results obtained from analyzing sectioned material. Abscissa—time after the accident; ordinate— $Q_L/Q_{RB}$**



Considering this, to determine uptake we used retention functions for compounds in class W; this was true for all TUE nuclides (on the assumption that separation of the nuclides of the fuel matrix did not occur in the lungs). Uptake was then determined for AMAD's of 1 and 10  $\mu$ . The unknown uptake of TUE was obtained in relation to different particle sizes (Table 2.2) from the measured systemic (extrapulmonary) radioactivity concentration (150 Bq). The nuclide composition given in Table 1.2 was used to calculate uptake and to estimate doses.

The retention function recommended by the ICRP<sup>7</sup> for one-time strontium uptake was used to determine the concentration of strontium isotopes in the body. It was by integrating and differentiating this function that we obtained the retention function we used in our calculations for chronic uptake and differential daily excretion. The permissibility of employing the retention function for the case of intravenous injection is confirmed by data obtained on the transportability of strontium aerosols

(20 percent) and by the measured ratio of the concentrations of strontium in lung and bone tissue of persons killed by radiation sickness.

It follows from an examination of measurements of <sup>90</sup>Sr concentrations obtained in 1986 (Table 2.3) that as the time of contact increases from three to 12 days to 74 days after the accident the average concentration of the isotope in the body does not increase in 105 of the subjects (group A), being around 0.8 kBq, or 1 percent of the permissible concentration ( $PC_A = 74$  kBq) for soluble compounds of <sup>90</sup>Sr, with the maximum concentration being equal to 0.23  $PC_A$ . These data indicate that uptake occurred primarily in the first weeks after the accident, as is also confirmed by the insignificant concentration of strontium in persons in group K (see Table 2.3). Data for 1987 for persons in group A (85) also indicate that noticeable additional uptake of <sup>90</sup>Sr was not observed, inasmuch as the average concentration (0.6 kBq) corresponds well, with regard for excretion, with the concentration detected in 1986 (0.8 kBq). The obtained data agree well with measurements of <sup>90</sup>Sr in sectioned material from deceased subjects (the average concentration was 0.6 kBq).

Table 2.3. Concentration of <sup>90</sup>Sr in the Body in 1986-1987

Examinations of	Number Examined	Time of Contact, Days	Average Concentration in the Body, Bq (percents of the $PC_A$ are in parentheses)	Ranges of Measured Concentration, Bq
Group A (1986)	56	1-3	960 (1.3)	$50-1.7 \times 10^4$
	82	1-12	930 (1.3)	$50-1.7 \times 10^4$
	105	1-74	810 (1.1)	$50-1.7 \times 10^4$
Group K (1986)	85	4-84	31 (0.043)	50-340
Associates of the Chernobyl Nuclear Power Plant and the Kombinat Production Association:				
Group A (1987)	85	1-60	590 (0.80)	50-6500
Group K (1987)	59	12-90	37 (0.05)	50-440

The concentration of strontium in the body of persons in group K was at approximately the same level in 1986 and 1987—that is, at around 0.05 percent of the  $PC_A$ , as determined from examining 144 persons, or 20 times less than in group A.

Following the same procedure as for TUE's, a group of people who had been in the city of Pripyat at the moment of the accident and in subsequent days (82 persons) was isolated from the group of subjects tested for strontium concentration. Concentrations were calculated separately both for them and for professionals who were working at the station at the moment of the accident and in subsequent days (108 persons). The data for 1987 were recomputed using the retention function for 120 days, and ultimately the average strontium concentration in the bodies of professionals was 1.1 kBq, or 2.7 times more than for the population at large.

Because the values of the retention function for one-time and chronic uptake (spanning a period of 100 days) are

rather close, being 0.19 and 0.23 respectively, we arrive at an average uptake for professionals equal to about 5 kBq, or less than 0.1 MPU.

## 2.2. Doses From Internal Irradiation Due to Inhalational Uptake of Radionuclides

Two programs were used to calculate doses on the basis of the ICRP lung model for a conditional (standard) individual. One of the programs makes it possible to obtain data associated with radionuclide biokinetics, while the other permits calculation of dose loads upon different target organs in the conditional individual. The raw data for the latter consist of the number of disintegrations in source organs (for example the lungs, bone tissue, liver, and gonads for TUE's).

Raw data used in calculating dose loads resulting from TUE's were obtained for one year, for 10 and 50 years, and for aerosols with AMAD's of 1 and 10  $\mu$  on the basis of estimates of inhalational uptake (see Table 2.2).

Because the larger part of radioactivity in measurements of sectioned material was recorded in bone tissue (at a ratio of 14:1), it was assumed in calculations for curium and americium that the fractions migrating out of the transitional chamber into bone tissue and the liver are 0.8 and 0.1, and not 0.45 each, as is assumed by the ICRP.

The anticipated equivalent doses given in Table 2.4 were calculated by means of a computer program utilizing

quality coefficients [5]. Doses are given for the maximally irradiated organs in each of three groups of critical organs. For the mixture of TUE's under consideration here, the critical organ is bone tissue, the average dose within which is around 0.4 MPU in the first year and 0.1 MPU in each subsequent year. Total irradiation in a period of 50 years corresponds to uptake on the order of 4 MPU. The doses would be 1.5 times smaller for the population at large, in proportion to the detected concentration.

**Table 2.4. Average Anticipated Equivalent Doses for Professionals Due to Inhalational Uptake of TUE's, mSv**

T, Years	Red Bone Marrow		Lungs		Bone Tissue	
	1 $\mu$	10 $\mu$	1 $\mu$	10 $\mu$	1 $\mu$	10 $\mu$
1	11	10	25	3.9	110	110
10	29	26	25	3.9	350	310
50	107	96	25	3.9	1340	1200

**Table 2.5. Average Anticipated Equivalent Doses for Professionals Due to Inhalational Uptake of  $^{90}\text{Sr}$ , mSv**

T, Years	Red Bone Marrow	Bone Tissue
1	0.85	0.45
10	4.2	1.9
50	6.9	2.4

According to examination data there are a group of persons with a TUE concentration noticeably above average, producing bone tissue doses of close to or more than 1 MPU in the first year. This group contains five out of the 199 examined persons (the five were personnel of the Chernobyl Nuclear Power Plant). When we average the results of not less than two measurements, their TUE concentration exceeds 370 Bq.

Table 2.5 gives the results of calculating doses for  $^{90}\text{Sr}$ . The calculations were carried out to arrive at the previously obtained average uptake. The doses would be 2.7 times smaller for the population at large. The obtained values of strontium-caused doses are significantly below not only the MPU but also the dose limit for the population.

As far as  $^{89}\text{Sr}$  is concerned, this nuclide was recorded in excreted matter prior to August 1986, and its average concentration, as determined from examining 62 persons, corresponded to uptake of around 1 kBq, which produces doses of approximately 0.02 mSv for red bone marrow and bone tissue. This dose is accumulated in its entirety within one year after the accident.

To estimate doses from other radionuclides, we used measurements made by A. V. Dmitriyev with an SICH unit. The measuring complex included a radiation counter based on a shielded germanium detector, and an NTA-1024 pulse analyzer connected to a 666/B computer. The measuring geometry was as follows: The detector was positioned on the backside of the individual as he lay on a couch, in the lower shoulder blade region. The counter was calibrated with a Bush model containing sample solutions of  $^{137}\text{Cs}$  and  $^{60}\text{Co}$ . The measurements were processed by a program, with the

following 10 nuclides being identified:  $^{95}\text{Zr}$ ,  $^{95}\text{Nb}$ ,  $^{103}\text{Ru}$ ,  $^{132}\text{Te}$ ,  $^{131}\text{I}$ ,  $^{134}\text{Cs}$ ,  $^{137}\text{Cs}$ ,  $^{140}\text{La}$ ,  $^{141}\text{Ce}$ ,  $^{239}\text{Np}$ . Concurrently the dose rate in the vicinity of the thyroid gland was measured with an SRP-68 instrument resting directly against it. Measurements made on 247 persons between 17 May 1986 and 13 June 1986 were used. Of these persons, 164 were personnel of the Chernobyl Nuclear Power Plant, while the rest could be included in the population at large. Most of them were tested in the biophysical laboratory for TUE and strontium concentrations. As a supplement to this, measurements of the concentrations of radionuclides in a control group of 45 persons (power plant personnel) examined after 13 June and prior to the end of August 1986, were analyzed. The data for this group were used to estimate the dynamics behind change in concentrations of different nuclides over time.

The averages of nuclide radioactivity in the body presented in Table 2.6 are related to the 35th day after the accident for power plant personnel (Per) and the population at large (Pop), and approximately to the 100th day for the control group of power plant personnel (PC); data pertaining to sectioned material (SM) pertain to approximately the 20th day. The last column in Table 2.6 gives the ratio of the TUE and cerium concentrations: In the case of sectioned material, the values fall into two distinct groups for which this ratio differs by an order of magnitude; moreover the data for one of them is close to what was found by examinations in the biophysical laboratory and with the SICH.

The isotope composition of nuclides does not differ noticeably in different groups, except for ruthenium isotope, for which a larger value is observed among

professionals in comparison with data from sectioned material, even if we take account of the fact that measurements with the SICH are overstated by a factor of two. The average concentration of  $^{132}\text{Te}$  and  $^{239}\text{Np}$  is

not shown in Table 2.6, because in view of their short half-life, they were considered with regard for the precise recording time—that is, their uptake and the doses they created were estimated separately.

**Table 2.6. Radioactivity of Radionuclides in the Body for Different Groups, kBq (relative to Zr in parentheses)**

Group	$^{95}\text{Zr}$	$^{95}\text{Nb}$	$^{103}\text{Ru}$	$^{106}\text{Ru}$	$^{134}\text{Cs}$	$^{137}\text{Cs}$	$^{141}\text{Ce}$	$^{144}\text{Ce}$	$\frac{\text{TUE}}{^{144}\text{Ce}}$
Per	4.1	5.9	24	9.3	4.1	20	2.0	2.0	0.072
	(1)	(1.4)	(5.8)	(2.3)	(1.0)	(4.9)	(0.49)	-(0.49)	
PC	4.4	5.5	12	4.8	5.6	13	0.9	-	-
	(1)	(1.3)	(2.7)	(1.1)	(1.3)	(3.0)	(0.20)	-	
Pop	4.1	3.7	8.9	3.7	2.8	16	1.5	1.5	0.067
	(1)	(0.9)	(2.2)	(0.9)	(0.7)	(4.0)	(0.37)	-(0.37)	
SM	16	27	27	11	24	58	12	13	0.004
	(1)	(1.7)	(1.7)	(0.69)	(1.5)	(3.6)	(0.75)	-(0.81)	0.040

**Table 2.7. Calculated Values of Radionuclide Uptake for Different Groups and Aerosol Particle Sizes, kBq**

Group	AMAD, $\mu$	$^{95}\text{Zr}$	$^{95}\text{Nb}$	$^{103}\text{Ru}$	$^{106}\text{Ru}$	$^{134}\text{Cs}$	$^{137}\text{Cs}$	$^{141}\text{Ce}$	$^{144}\text{Ce}$
Per	1	40	24	260	59	9.2	43	34	14
	10	160	100	810	180	5.8	28	120	56
Pop	1	40	15	100	23	6.3	3.5	25	11
	10	160	65	310	73	4.0	22	89	43

**Table 2.8. Average Anticipated Equivalent Doses for Professionals Due to Inhalational Uptake of  $\gamma$ -Emitting Radionuclides, mSv**

T, Years	Red Bone Marrow		Lungs		Bone Tissue	
	1 $\mu$	10 $\mu$	1 $\mu$	10 $\mu$	1 $\mu$	10 $\mu$
1	1.2	2.4	80	60	6.0	15
50	1.3	2.5	100	75	6.3	16

The dynamics behind change in radioactivity in the body over the period in question indicate slow reduction of radioactivity over time, which is also confirmed for most nuclides by data for the control group. Attempts to obtain average characteristics for metabolism of inhaled nuclides were unsuccessful in view of the small number of repeated measurements. Comparison of functions describing change in measured radioactivity with functions describing elimination from the body in accordance with the ICRP model shows that zirconium, niobium, ruthenium and cerium should be placed in class G, tellurium and neptunium should be placed in class N, and cesium should be placed in class D. This is also confirmed by data on aerosol transportability, presented earlier. With regard for the fact that the aerosols of some nuclides were given in the form of two fractions, uptake and doses were calculated for AMAD's of 1 and 10  $\mu$  (tables 2.7 and 2.8).

The obtained dose values depend weakly on aerosol particle size distribution, which makes it possible to adopt average estimates. The lungs are the critical organ for the nuclides in question. The average dose for them is

around 0.5 MPU for the first year, during which 80 percent of the dose anticipated over a period of 50 years is accumulated. The main contribution to the dose received by the lungs is made by  $^{106}\text{Ru}$  (55 percent),  $^{239}\text{Np}$  (20 percent) and  $^{144}\text{Ce}$  (up to 10 percent).

These data were obtained only in relation to actually measured radionuclides, without regard for the effects of many short-lived nuclides. Analysis of the function describing change in integral energy release by fuel of an RBMK-1000 reaction during an analysis time of one hour to 10 days [3] shows that it decreases by approximately five times (for the total of  $\beta$ - and  $\gamma$ -radiation). Approximately the same multiple can probably also be adopted for estimates of the maximum dose received by lung tissue in the first year after the accident.

The dose received by the thyroid gland was also calculated on the basis of measurements of its radioactivity by an SRP [not further identified] instrument. The average dose for the group of professionals (164 persons) was equal to 240 mSv (the median was 200 mSv). If we

consider the contribution by other iodine isotopes, introducing a correction factor<sup>8</sup> we get 410 +/- 340 mSv—that is around 2.7 MPU. With regard for error, these results agree well with published data [2] and other measurements known to us.

Summing the doses from internal radiation caused by TUE's, strontium isotopes and  $\gamma$ -emitting nuclides, we arrive at the result shown in Table 2.9. As an illustrative assessment Table 2.10 gives the total doses for the examined population group.

**Table 2.9. Total Dose From Internal Irradiation Due to Inhalational Uptake of Radionuclides as a Result of the Chernobyl Nuclear Power Plant Accident, for Professionals, mSv (relative to the MPU in parentheses)**

T, Years	Red Bone Marrow	Lungs	Thyroid Gland	Bone Tissue
1	13 (0.26)	84 (0.56)	410 (2.7)	120 (0.40)
10	31 (0.06)	100 (0.07)	-	350 (0.12)
50	110 (0.04)	100 (0.1)	-	1300 (0.09)

**Table 2.10. Total Doses From Internal Irradiation Due to Inhalational Uptake of Radionuclides as a Result of the Chernobyl Nuclear Power Plant Accident, for the Population at Large, mSv (relative to the dose limit for the critical organ in parentheses)**

T, Years	Red Bone Marrow	Lungs	Thyroid Gland	Bone Tissue
1	6.4 (1.3)	26 (1.7)	320 (21)	73 (2.4)
50	70	35	320	870

### Conclusion

A number of conclusions common to professionals and the population at large are implied by the results. Internal irradiation of all organs and tissues (with the exception of bone tissue and red bone marrow) caused by inhalation of a radionuclide mixture is practically complete in the first year after the accident, with the critical organ being the thyroid gland. Internal irradiation in subsequent years is determined almost wholly by the transuranium elements, and for bone tissue it is around 0.1 MPU per year for professionals and around half the annual dose limit for the population at large.

If we wish to assess the role of internal irradiation and its contribution to total irradiation, we need to analyze the obtained data with regard for external irradiation. If we

assume that the average dose from external irradiation of Chernobyl Nuclear Power Plant personnel in the first year was, as an example, 200 mSv, and if we sum it together with doses from internal irradiation, then we arrive at the final results shown in Table 2.11. It follows from these data that on the average, the contribution by internal irradiation does not cause the permissible limit to be exceeded by any organ or by the body as a whole (5 MPU in the case of an accident situation, with subsequent compensation).

Internal irradiation may be described by just the effective equivalent dose (EED), which for professionals is 30 mSv in the first year, and 85 mSv for 50 years. Then the total EED for an average dose of 200 mSv caused by external irradiation is 230 mSv, while the contribution of internal irradiation to the total is around 13 percent.

**Table 2.11. Total Average Dose From External and Internal Irradiation for Professionals in the First Year After the Accident (mSv in parentheses)**

Entire Body	Red Bone Marrow	Lungs	Bone Tissue	Thyroid Gland
4 MPU	4.3 MPU	1.9 MPU	1.1 MPU	4.1 MPU
(200)	(213)	(284)	(320)	(610)

However, there is a certain critical group of persons with a maximum, or close to maximum, concentration of radionuclides, for whom the dose from internal irradiation exceeds the average values; when it comes to them, the issue must be examined individually, with regard for the actual concentration of radionuclides in the body and doses due to external irradiation. According to the measurements of the body's radionuclide concentration presented here, the size of this group is around 2-3 percent of the total number of workers at the power plant in the first days and weeks after the accident.

In conclusion the authors express deep gratitude to many associates of the institute and other institutions for their great and extremely responsible and meticulous work in carrying out the analyses and examinations.

### Footnotes

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#### Absorbed Doses in the Thyroid Gland and Organization of Endocrinological Monitoring of UkSSR Inhabitants After the Chernobyl Nuclear Power Plant Accident

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[Article by A. Ye. Romanenko, I. A. Likhtarev, N. K. Shandala, G. M. Gulko, I. A. Kayro, A. K. Cheban, N. I. Chepurnoy, O. S. Degtyareva and O. V. Kopylova, All-Union Scientific Center for Radiation Medicine, USSR Academy of Medical Sciences, Kiev]

UDC 616.441-001.29-02:[614.876:614.83]  
"CHERNOBYL"(477)

[Text] In the first stage following the accident at the Chernobyl Nuclear Power Plant (approximately until July 1986),  $^{131}\text{I}$  was one of the leading sources of the population's radioactive exposure. Given the situation that came about in the Ukraine, this is why the problem arose of organizing immediate measurements of the concentration of radioactive iodine in the thyroid gland of adults and children with the purpose of determining the individual and collective exposure doses of this organ and subsequently evaluating the possible negative consequences, and with the purpose of finding an optimum strategy for organizing medical care for the population in the period following the accident.

#### Materials and Methods

Specialized dosimetric teams (over 100) made over 150,000 individual determinations of thyroid gland radioactivity in the population by means of various detection systems in Ukraine in May-June 1986, with the participation and methodological guidance of specialists of a "disaster team" from the Leningrad Scientific Research Institute of Marine Transportation Hygiene of the USSR Ministry of Health (L. R. Romanov, G. L. Moroz, A. N. Kovtun and others). The results of these massive tests were laid at the basis of the present estimates of individual absorbed irradiation doses of the thyroid gland of children and adults, caused by  $^{131}\text{I}$  in the early ("iodine") period of the Chernobyl accident.

A dosimetric iodine data bank containing information on exposure of the thyroid gland of the UkSSR population was created as a means of organizing work with this body of measurements. The data bank is one of the local structures of the Central Dosimetric Register, Department of Dosimetry and Radiation Hygiene, All-Union Scientific Center for Radiation Medicine (VNTsRM), USSR Academy of Medical Sciences.



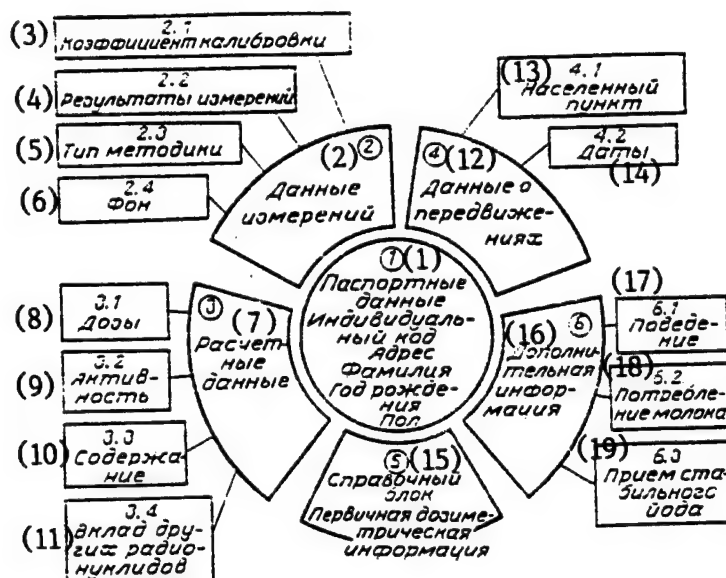


Figure 1. Structure of the Dosimetric Data Bank of Individual Thyroid Gland Irradiation Doses

Key: 1. Personal information: individual code; address; name; year of birth; sex 2. Measured data 3. Calibration coefficient 4. Measurement results 5. Type of procedure 6. Background 7. Calculated data 8. Doses 9. Radioactivity 10. Concentration 11. Contribution by other radionuclides 12. Data on movements 13. Population center 14. Dates 15. Reference unit; primary dosimetric information 16. Supplementary information 17. Behavior 18. Milk consumption 19. Stable iodine ingestion

The data bank was managed by IBM 3-60 personal computers and DBASE 3+, FOXBASE+ and DBASE 4 data base control systems. In addition a software system making it possible to carry out the necessary input-output and data processing operations was developed.

The principal structural units of the dosimetric iodine data bank are (Figure 1) a personal information block (1), an instrumental measurement results block (2), a block calculating the concentration of radioactive iodine in the thyroid gland and its irradiation doses (3), a block containing information on the movements of individuals during the iodine period of the accident (4), a primary information reference library block (5), and a supplementary data block (6). The last block contains information on the particular behavioral routines of the population, on milk consumption, on utilization of radioprotective measures, and on the parameters of metabolic models describing the behavior of radioactive iodine in the human body and thyroid gland and in the environment. Data of this type are supplemented as information is accumulated.

The formalized individual card describing dosimetric monitoring of thyroid gland irradiation is the information unit of the iodine data bank (Figure 2). It bears the person's individual code, the administrative code of his location at the time of the accident, the individual's personal information, information on the place of storage of primary information, data on the date and

places of evacuation, the results of calculating exposure doses using different models of radioactive iodine uptake, and so on.

## Results and Discussion

The scale of influence of radioactive iodine can be assessed from the distribution of children (up to 15 years old at the moment of the accident) and adults in relation to the spectrum of thyroid gland irradiation doses (Figure 3). An analysis was made of the eight rayons in the UkSSR that suffered the most from radioactive iodine: in Kiev Oblast—Chernobyl'skiy, Poles'skiy and Ivankov'skiy rayons and the city of Pripyat; in Zhitomir Oblast—Narodich'skiy and Ovruch'skiy rayons; in Chernigov Oblast—Kozel'skiy, Repkinskiy and Chernigov'skiy rayons.

It should be noted that the distribution was plotted on the basis of instrumental measurements of the concentration of radioactive iodine in the thyroid gland. However, while a significant fraction of the population was subjected to measurements (from 50 to 90 percent), it was still only a fraction. Therefore the patterns of this distribution were extended to the entire population of the mentioned territories.

Figure 3 shows the results of estimating doses on the basis of the most conservative model of "one-time uptake" of radioactive iodine (the first stage in calculating the doses), and on the basis of a more realistic model accounting for



(1) **ИНДИВИДУАЛЬНАЯ КАРТА**  
**ДОЗИМЕТРИЧЕСКОГО ИОДНОГО БАНКА ДАННЫХ**

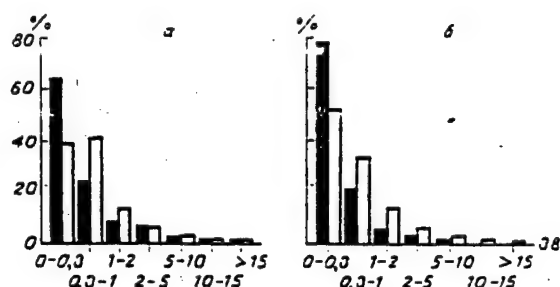
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		(11) N пациента XXXX	
(12) доза щж XXXXX.X		(13) коррект. доза XXXXX.X	
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(16) номер методики XX	(17) результат измер. XXXXX.X	(18) фон XXXXX.X	(19) коэф. градуировки XX.XXXXXX
(20) дата измерения XX XX XX	(21) дата реэвакуации XX XX XX	(22) примеч. <input type="checkbox"/>	

Figure 2. Formalized Individual Card for the Dosimetric Data Bank Containing Information on Thyroid Gland Irradiation

Key: 1. Individual dosimetric iodine data bank card 2. Individual code 3. Administrative code 4. Last name 5. First name 6. Patronymical 7. Year of birth 8. Sex 9. File number 10. Report number 11. Patient number 12. Thyroid gland dose 13. Corrected dose 14. Evacuation date 15. Evacuation place code 16. Procedure number 17. Measurement results 18. Background 19. Calibration coefficient 20. Date of measurement 21. Date of reevacuation 22. Remarks

individual dynamics of its uptake (the first stage in correcting the doses). The entire array of information for the indicated rayons, stored in the iodine dosimetric data bank, was used in the computer calculations. It should be noted that preliminary population distributions based on thyroid gland irradiation doses were plotted on the basis of primary paper documents, without any special computer

processing, in order to arrive at a quick appraisal of the iodine situation in the preparatory stage of the efforts to form the data bank (efforts to systematize and formalize instrumental measurements of the concentration of radioactive iodine in the thyroid gland). After this, collective exposure doses of this organ were calculated, and a preliminary assessment of the magnitudes of possible remote



**Figure 3. Distribution of Individual Thyroid Gland Exposure Doses in Children (a) and Adults (b) Residing in Eight Rayons of the UkSSR and in the City of Pripyat: Here and in Figure 4: light columns—calculations based on the acute uptake model; dark columns—with regard for prolonged individual uptake. Abscissa—thyroid gland irradiation dose; ordinate—population size**

thyrogenic consequences was made. In addition we prepared and forwarded information on individual thyroid gland exposure doses for over 600,000 children of the UkSSR for inclusion in the all-union register of victims of the Chernobyl Nuclear Power Plant accident.

As follows from Figure 3a, in the range of doses up to 2 Sv ("conditionally subthreshold" in relation to radiation hypothyroidism [3]), calculated using the most conservative model of one-time uptake, the number of children is estimated at 79,500, with around 38,000 in the small dose range (up to 0.3 Sv), and 12,300 in the range of doses over 2 Sv (the entire right side of the distribution). It should be considered that use of such a conservative estimate of individual thyroid gland exposure doses produces somewhat overstated values of these doses.

Estimates accounting for the individual dynamics of radioactive iodine uptake by the human body are more adequate. The nature of the distribution changes somewhat when these dynamics are taken into account. Changes of this sort in children and adults reduce basically to a shift of the distribution into the region of small doses, and enlargement of the size of the dose group in the 0-0.3 Sv interval (56,200 children).

As far as the adult population is concerned (see Figure 3b), the magnitudes of the thyroid gland irradiation doses are lower on the average than in children (according to both the conservative model and the first correction model). This is explained by the fact that first of all, the thyroid gland irradiation dose is found to be lower per unit of incorporated radioactivity owing to the increase in weight of the thyroid gland with age. Second, iodine pressure was exerted in a number of cases primarily through the ecological channel, and specifically by way of contaminated milk. However, the cultural make-up of the children's ration in the stricken areas is such that milk is an essential component of the diet.

It should be noted that correction of the thyroid gland irradiation dose, carried out with regard for the individual time of radioactive iodine uptake, is the first stage of dosimetric correction. Further work in this direction presupposes using models of radioactive iodine uptake by the human body, ones which account for the characteristics of the dynamics of environmental contamination and the regional features of iodine metabolism.

Going on to assessing possible remote consequences associated with irradiation of the thyroid gland, we note that predictions were made both for the juvenile part of the population (this contingent is critical in relation to anticipated radiation-induced thyroid pathology, considering the high radiosensitivity of the child's thyroid gland [3], and in relation to duration of subsequent life) and for adults. Selecting acceptable values for the risk factors of possible thyroid pathology is an extremely important task.

The possible values of risk factors of radiation-induced thyroid pathology were discussed in connection with new assessments of prognostic risk published by international scientific organizations during the All-Union Working Conference on the Problem "The Thyroid Gland," held 28 November 1989 at the VNTsRM of the USSR Academy of Medical Sciences. The risk factor of induction of all forms of malignant tumors of the thyroid gland was adopted at this conference equal to 40 tumors per 10,000 man-Sv for the population up to 18 years old, and 10 tumors for persons above 18 years. It should be noted that the cited lifetime risk factors are extremely conservative, being averaged over the entire range of available data. They account for: differences in the radiosensitivity of children and adults, and of men and women; the factor of the low external irradiation dose rate (equal to 3); the average time of presence in "risk conditions," equal to a subsequent life span of 60 years (with regard for a minimum latent period of five years and 1986 birth groups); the heightened oncogenic effectiveness of external irradiation (by three times in comparison with internal irradiation from  $^{131}\text{I}$ ). The adopted value of lifetime risk must be used in all subsequent calculations, and to correct predictions made earlier (when different researchers used risk factors of the remote consequences of thyroid gland irradiation within an interval of 7-100 tumors per 10,000 man-Sv).

In this paper we adopted a risk factor of induction of all forms of malignant tumors of the thyroid gland equal to 40 for children and 10 for adults (with the level of incurable malignant tumors adopted at 10 percent), and in the case of hypothyroidism, 100 cases per 10,000 man-Sv.

The initial estimates of the magnitude of the remote consequences in children residing in stricken rayons were made on the basis of collective thyroid gland irradiation doses, calculated with regard for the time of uptake of radioactive iodine by the body (Figure 4). Thus according to the most conservative estimate the collective thyroid tumor-producing dose experienced by the

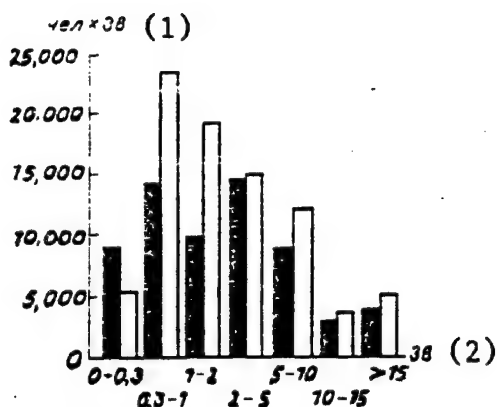


Figure 4. Distribution of Collective Thyroid Gland Irradiation Doses in Children Residing in Eight Rayons of the UkSSR and Pripjat: Abscissa—thyroid gland exposure dose; ordinate—collective doses

Key: 1. Man-Sv 2. Sv

thyroid gland is 116,000 man-Sv, while the collective hypothyroidism-inducing dose is close to 73,000 man-Sv. In all, possible appearance of radiation-induced malignant tumors of the thyroid gland was predicted at 464 cases among children, to include 47 incurable cases; the number of cases of radiation-induced hypothyroidism was predicted at 733. A refined prediction of the remote consequences based on calculating doses using a more realistic model that accounts for individual time of radioactive iodine uptake showed that the collective thyroid tumor-inducing dose is 74,000 man-Sv, while the collective dose inducing hypothyroidism is 42,000 man-Sv. This means that a basic possibility exists for the advent of 300 cancerous tumors of the thyroid gland (30 incurable) and 418 cases of radiation-induced hypothyroidism.

As far as the adult population is concerned, the collective thyroid tumor-inducing dose, calculated using a model of one-time radioactive iodine uptake, was 369,000 man-Sv, which is sufficient for an additional 369 malignant tumors, 37 of which are incurable. When the more realistic dosimetric model of long-term radioactive iodine uptake is used, the collective thyroid tumor-inducing dose received by the adult thyroid gland is almost 2.4 times lower, being 156,000 man-Sv. Possible appearance of a noticeably smaller quantity of malignant tumors—156 (including 16 incurable) is predicted on the basis of this last value.

Unfortunately the absolute estimates presented here for the possible number of radioactive oncogenic effects in the thyroid gland are difficult to compare with the spontaneous level, inasmuch as very little data are available on this level for the regions in question. Can world observations be utilized? Only with very serious qualifications, since the variability of spontaneous thyroid oncogenesis is extremely great in different countries of

the world. For this reason we can accept two cases per year per 100,000 persons as a certain "plausible" estimate.<sup>1</sup>

In principle, considering the subsequent life span, the spontaneous level of incidence of thyroid cancer may be exceeded by 2.5 times in the next 60 years in children living in UkSSR rayons that suffered the most from radioactive iodine. It should be emphasized that these extremely approximate estimates, which nonetheless should be seen as maximums, do not account for one serious factor—growth of the spontaneous level itself over time.

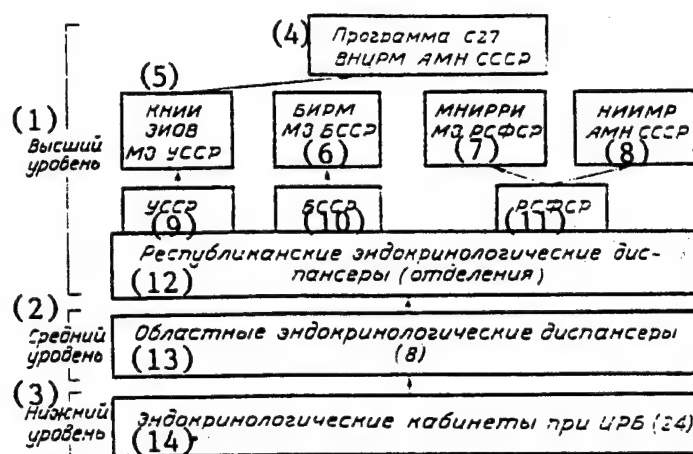
From our point of view it would be suitable to discuss our estimates of collective thyroid gland irradiation doses and predictions of possible medical consequences of such radioactive exposure in connection with values published earlier [1]. The data presented in this paper for the anticipated remote consequences of thyroid gland exposure indicate that in most cases, the predicted estimates of anticipated additional thyroid tumor-inducing consequences may be 5 and 0.9 percent respectively for children and adults on the entire territory of the USSR's central regions.

As far as the territory of the UkSSR *per se* is concerned, the values in the cited paper for both doses and risks are noticeably lower than in this article. This is explained by the fact that the data on exposure doses used in [1] were purely preliminary: They were associated with the earliest stage of formation of the dosimetric iodine data bank for information on individual exposure of the thyroid gland of UkSSR residents. Moreover the authors of [1] used less-conservative risk factor values than we did in calculating the possible anticipated thyroid tumor-inducing consequences of both children and adults.

These conservative predicted estimates of possible remote consequences of irradiation of the thyroid gland in children served as the basis for developing a branched system for monitoring endocrinological diseases, chiefly of the thyroid. The structure of this system and the network of specialized medical institutions for diagnosis and treatment of possible thyroid pathology in children is shown in Figure 5.

This specialized endocrinological monitoring network includes: a bottom level, supported by 24 offices at the corresponding central rayon hospitals; a middle level supported by eight oblast endocrinological dispensaries, and a top level, the so-called expert clinical and scientific consultative level, at which three republic dispensaries and five specialized scientific institutes of the USSR Academy of Medical Sciences and of union republic ministries of health operate.

The information contained in the iodine data bank must be used as the dosimetric basis for determining the group of persons subject to long-term specialized endocrinological observation, so that possible remote consequences of exposure of the thyroid gland can be revealed. These groups were formed with regard for age at the moment of

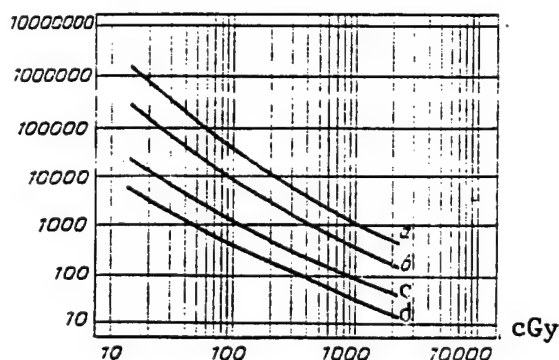


**Figure 5. Interaction of Organizational Structures for Endocrinological Examination of Children**

Key: 1. Top level 2. Middle level 3. Bottom level 4. Program S27, VNTsRM USSR Academy of Medical Sciences 5. KNII ZIOV [not further identified], UkSSR Ministry of Health 6. BIRM [not further identified], BSSR Ministry of Health 7. MNIRRI [not further identified], RSFSR Ministry of Health 8. NIIMR [not further identified], USSR Academy of Medical Sciences 9. UkSSR 10. BSSR 11. RSFSR 12. Republic endocrinological dispensaries (departments) 13. Oblast endocrinological dispensaries (8) 14. Endocrinological offices at central rayon hospitals (24)

the accident (up to 15 years), for the level of instrumentally measured thyroid gland exposure doses, for place of residence, for endemicity (with respect to stable iodine) of places of residence, and a number of other indicators.

It should be noted that acquisition of strict, scientifically justified results of epidemiological research can be guaranteed only if individuals to be kept under observation are properly grouped. This is why special attention was devoted to this question.



**Figure 6. Required Size of Dose-Dependent Observation Groups Depending on the Individual Thyroid Gland Irradiation Dose: See text for explanation. Abscissa—thyroid gland irradiation dose; ordinate—dose group size**

**Sizes of Dose-Dependent Observation Groups on the Clinical Dosimetric Thyroid Register**

Dose Group, Sv	Group Size, Number of Persons	Anticipated Morbidity Over 35 Years, Number of Cases	
		Spontaneous	Radiation-Induced
0-0.3	260,000	182	39
0.3-1	19,000	13.3	12.4
1-2	5,000	3.5	7.5
2-5	1,500	1.1	5.3
5-10	600	0.4	4.5
10-15	340	0.2	4.3
> 15	200	0.1	4.1

Figure 6 gives calculated estimates of the required observation group size at a level of spontaneous thyroid cancer morbidity equal to 70 cases in 35 years (five to 40 years after irradiation). Given the values for the risk of radiation-induced cancer considered here (four, 10, 40 and 100 cases per 10,000 man-Sv—a, b, c, d in Figure 6 respectively), groups of the indicated size make it possible to basically detect an anticipated increase in morbidity with 95 percent confidence (if of course such an increase is observed at all). The table gives the calculated minimum necessary size of dose groups at a thyroid gland risk factor of 10 cases per 10,000 man-Sv (a conservative estimate). It follows from this that we can say with a high degree of certainty that it would be practically impossible to form a truly representative

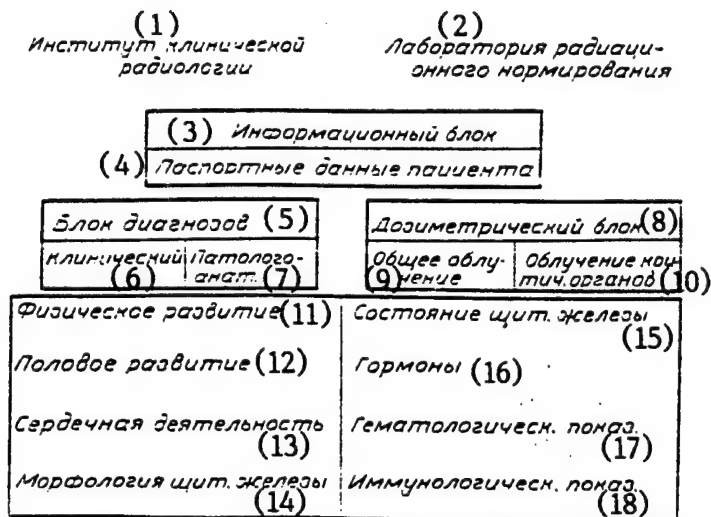


Figure 7. Structure of the Specialized Medical Dosimetric Thyroid Register

Key: 1. Clinical radiology institute 2. Radiation standardization laboratory 3. Information block 4. Patient personal information 5. Diagnosis block 6. Clinical 7. Pathoanatomical 8. Dosimetric block 9. Total irradiation 10. Irradiation of critical organs 11. Physical development 12. Sexual development 13. Cardiac activity 14. Thyroid gland morphology 15. State of the thyroid gland 16. Hormones 17. Hematological indicators 18. Immunological indicators

group in the 0-0.3 Sv dose interval, and extremely difficult in the 0.3-1 Sv interval. Epidemic data can be obtained for these dose intervals only as a result of mass "simplified screening" for thyroid pathology, conducted in regions suffering damage from radioactive iodine. In this case, thorough analysis is not only technically unachievable, but also apparently unsuitable.

One of the main objectives today is to support the function of the Specialized Medical Dosimetric Thyroid Register,<sup>2</sup> the basic structural units of which are information, diagnostic, dosimetric and medical blocks (Figure 7). The last includes indicators describing the state of the thyroid gland, the physical and sexual development of the individual, and the results of hematological, immunological, hormonal and other analyses. An individual formalized endocrinological monitoring card was developed for management of the medical dosimetric data bank<sup>3</sup> (Figure 8).

The authors associate the immediate future of their work with the following objectives.

1. Studying the dependence of the parameters of the distribution of thyroid gland irradiation doses on distance to the "source" (the Chernobyl Nuclear Power Plant): along the axes of the southern and western paths, and in the spaces between these axes.
2. Making further corrections of dose values in relation to different uptake models (using refined uptake function parameters): inhalational (one-time), alimentary (prolonged) and mixed.
3. Studying the ratios of all three types of uptake as functions of the distance to the "source" using a radial-circular grid.
4. Studying the frequency of possible remote consequences of thyroid gland irradiation in different dose groups with the purpose of verifying and refining the absolute and relative risk factors for radiation-induced oncological and functional thyroid pathology.
5. Emergency clinical treatment of oncological and functional pathology, if the need for this arises.

(1) ИНДИВИДУАЛЬНАЯ КАРТА  
ПАЦИЕНТА

(2) ( стр. 1 )

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		(12) ист. болезни	<input type="text"/>
(13) прожив. в 1986г.	<input type="text"/>	(14) прожив. в наст. время	<input type="text"/>

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(18) щитовидной железы, сЗв	<input type="text"/>

(19) ДИАГНОЗЫ:	
(20) МКБ1	<input type="text"/>
(21) МКБ2	<input type="text"/>
(22) обследования:	дата <input type="text"/>
(23) расширенный диагноз:	(24) состояние щит. железы:
	(25) диф. гиперплаз. 1-2, эл.
	(26) диф. гиперплаз. 1-2, пл.
	(27) диф. зоб >=3ст., эласт.
	(28) диф. зоб >=3ст., плотн.
	(29) смешанный зоб
	(30) болезненная железа
	(31) узловой зоб
	(32) многоузловой зоб

(33) ФИЗИЧЕСКОЕ РАЗВИТИЕ:	
(34) рост	<input type="text"/> м.
(35) масса	<input type="text"/> кг.
(36) окружность грудной клетки:	<input type="text"/> см.
(37) оценка развития:	
(38) низкое	<input type="checkbox"/>
(39) ниже среднего	<input type="checkbox"/>
(40) среднее	<input type="checkbox"/>
(41) выше среднего	<input type="checkbox"/>
(42) высокое	<input type="checkbox"/>

(43) ПОЛОВОЕ РАЗВИТИЕ:	
(44) оценка развития:	
нормальное	(45) <input type="checkbox"/>
преждевременное	(46) <input type="checkbox"/>
отстает	(47) <input type="checkbox"/>
(48) наличие менстр.:	
есть	(49) <input type="checkbox"/>
нет	(50) <input type="checkbox"/>

Figure 8. Formalized Individual Clinical Dosimetric Endocrinological Monitoring Card (consisting of pages 1, 2, 3)

Key: 1. Individual patient card 2. Page 1 3. Personal information 4. Last name 5. First name 6. Patronymical 7. Date of birth 8. Sex 9. Observation category 10. Accounting group 11. Individual code 12. Disease history 13. Residence in 1986 14. Current residence 15. Irradiation doses 16. External, cSv 17. Internal, cSv 18. Thyroid gland, cSvT 19. Diagnoses 20. МКБ1 [not further identified] 21. МКБ2 [not further identified] 22. Examination date 23. Expanded diagnosis 24. Condition of thyroid gland 25. Diffuse hyperplasia 1-2, elastic 26. Diffuse hyperplasia 1-2, hard 27. Diffuse goiter, less than or equal to 3 st. [not further identified], elastic 28. Diffuse goiter, less than or equal to 3 st. [not further identified], hard 29. Mixed goiter 30. Painful gland 31. Nodular goiter 32. Multinodular goiter 33. Physical development 34. Height, m 35. Weight, kg 36. Chest size, cm 37. Assessment of development 38. Low 39. Below average 40. Average 41. Above average 42. High 43. Sexual development 44. Assessment of development 45. Normal 46. Premature 47. Retarded 48. Menstruation 49. Yes 50. No



(1) ИНДИВИДУАЛЬНАЯ КАРТА  
ПАЦИЕНТА

(2) ( стр. 2 )

(3) УЗ И щитовидной железы			
(4) ЛЕВАЯ ДОЛЯ			
(5) размер	_____ мм,	(6) объем	_____ см <sup>3</sup> , контур
			четкий (8) / нечет. (9)
(10) эхо-структура:	однородная (11) / неоднородн. (12)	(13) эхогенность:	нормальная (14) / выше нормы (15) / ниже нормы (16)
(17) ПРАВАЯ ДОЛЯ			
размер	_____ мм,	объем	_____ см <sup>3</sup> , контур
			четкий / нечет.
эхо-структура:	однородная / неоднородн.	эхогенность:	нормальная / выше нормы / ниже нормы

(18) очаговые изменения в щж			
(4) ЛЕВАЯ ДОЛЯ:			
продольные (19) эхопозитивные включения:	(20) есть, < 4мм / есть, > 4мм / < и > 4мм / нет (22)	(24) эхопозитивные узлы:	один (25) / много (26) / нет (22)
продольные (23) эхонегативные включения:	есть, < 4мм / есть, > 4мм / < и > 4мм / нет	(27) эхонегативные узлы:	один / много / нет
(17) ПРАВАЯ ДОЛЯ:			
продольные эхопозитивные включения:	есть, < 4мм / есть, > 4мм / < и > 4мм / нет	эхопозитивные узлы:	один / много / нет
продольные эхонегативные включения:	есть, < 4мм / есть, > 4мм / < и > 4мм / нет	эхонегативные узлы:	один / много / нет

(28) ЭКГ исследования			
(29) пульс	_____ 1/мин	PQ	_____ QRS
			QT
(30) ритм:	правильный (31) / синус. аритмия (32) / экстрасист. аритмия (33) / мерцательн. аритмия (34) / другая (35)	(36) изменения миокарда:	норма (37) / умеренные (38) / выраженные (39) / очаговые (40)

Figure 9

Key: 1. Individual patient card 2. Page 2 3. Thyroid gland UZI [not further identified] 4. Left lobe 5. Size 6. Volume 7. Outline 8. Distinct 9. Indistinct 10. Echo structure 11. Homogeneous 12. Inhomogeneous 13. Echo generation 14. Normal 15. Above normal 16. Below normal 17. Right lobe 18. Focal changes in thyroid gland 19. Longitudinal echo-positive inclusions 20. Present 21. And 22. Absent 23. Longitudinal echo-negative inclusions 24. Echo-positive nodes 25. One 26. Many 27. Echo-negative nodes 28. EKG analysis 29. Pulse, /min 30. Rhythm 31. Regular 32. Sinus arrhythmia 33. Extrasystolic arrhythmia 34. Flickering arrhythmia 35. Other 36. Changes in myocardium 37. Normal 38. Moderate 39. Pronounced 40. Focal

(1) ИНДИВИДУАЛЬНАЯ КАРТА  
ПАЦИЕНТА  
(2) ( стр. 3 )

(3) ОБЩИЙ АНАЛИЗ КРОВИ

(4) эритроциты   $\cdot 10^{12}$  /л. (5) гемоглобин  г/л. (6) цвет. показ. ,  
(9) лейкоциты   $\cdot 10^9$  /л. (10) в т.ч.: (11) базофилы  %, (12) эозинофилы  %, (13) юн. нейтрофилы  %, (14) палочкоядерные  %, (15) сегментоядерные  %, (16) лимфоциты  %, (17) моноциты  %, (18) тромбоциты  %, (19) СОЭ  мм/ч (20)

(21) БИОХИМИЧЕСКИЕ ИССЛЕДОВАНИЯ

(22) Общ. белок  г/л. (23) Белковые фракции: (24) альбумин  %, (25) глобулин  %, (26) А-глоб.  %, (27) Б-глоб.  %, (28) Г-глоб.  %, (29) Б-липопрот.  г/л. (30) билирубин  ммоль/л. (31) холестерин  ммоль/л. (32) фосфор ; Ca ; K ; Na ; сахар  ммоль/л. ч (34)

(35) ИММУНОЛОГИЧЕСКИЕ ИССЛЕДОВАНИЯ

(36) Т-лимфоциты , (37) Т-хелперы , (38) Т-супрессоры   $\cdot 10^{-9}$  л<sup>-1</sup>  
(39) В-лимфоциты , Т-киллеры   $\cdot 10^{-9}$  л<sup>-1</sup>  
Ig G  г/л; (40) Ig A  г/л; Ig M  г/л;  
антитела к тиреоглобулину  МЕД/л. (41) антитела к микросомам  % (42)

(43) ГОРМОНАЛЬНЫЕ ИССЛЕДОВАНИЯ

(44) общ. тироксин  нмоль/л. (45) общ. трийодтиронин  нмоль/л. (46) ТТГ  МЕД/л. (47) пролактин  нг/мл. (48) кортизол  нмоль/л. (49) паратгормон  пг/мл. (50) тиреокальцитонин  пг/мл. (51) тиреоглобулин  (54)

Figure 10

Key: 1. Individual patient card 2. Page 3 3. General blood analysis 4. Erythrocytes 5. liter 6. Hemoglobin 7. gm/liter 8. Color indicators 9. Leukocytes 10. Including 11. Basophils 12. Eosinophils 13. Young neutrophils 14. Filament polymorphonuclear 15. Segmented 16. Lymphocytes 17. Monocytes 18. Thrombocytes 19. Sedimentation rate 20. mm/hr 21. Biochemical analysis 22. Total protein 23. gm/liter 24. Protein fractions 25. Albumin 26. Globulin 27. B-lipoprotein 28. Bilirubin 29.  $\mu$ moles/liter 30. Cholesterol 31. mmoles/liter 32. phosphorus 33. Sugar 34. mmoles/liter x hour 35. Immunological analysis 36. T-lymphocytes 37. T-helpers 38. T-suppressors 39. T-killers 40. gm/liter 41. Antibodies to thyroglobulin 42. Antibodies to microsomes 43. Hormone analysis 44. Total thyroxine 45. nanomoles/liter 46. Total triiodothyronine 47. Thyrotropic hormone 48. Prolactin 49. nanograms/ml 50. Cortisone 51. Parathyroid hormone 52. picograms/ml 53. Thyrocalcitonin 54. Thyroglobulin

## Footnotes

1. Considering the data in [3] and the fact that appearance of radiation-induced tumors may be anticipated primarily in a period of five to 40 years after irradiation [4], there are grounds for assuming that the spontaneous thyroid cancer morbidity among children (born 1971-1986) in this period may be on the order of 180 malignant tumors (60-400 depending on age and sex) per 100,000 persons. The spontaneous level of clinically revealed cases of thyroid cancer was estimated in [2] at 2.6 per 100,000 persons per year among men, and 8.2 among women. According to A. Ye. Prisyazhnyuk's data (oral communication), the same indicator for the northern Ukraine is one to two cases per year.

2. This register is being managed in the VNTsRM of the USSR Academy of Medical Sciences by the endocrinological department of the Institute of Clinical Radiology and the department of dosimetry and radiation hygiene (radiation standardization laboratory) of the Institute of Epidemiology and Prevention of Radiation Injury.

3. This formalized card was reviewed and approved by an all-union conference for use in stricken regions of the RSFSR and BSSR as well.

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### Pathogenesis and Treatment of Epichlorohydrin Burns to Eyes (Experimental Clinical-Morphological Investigation)

917C0604A Moscow VESTNIK OFTALMOLOGII in Russian Vol 107 No 1, Jan-Feb 91 pp 12-16

[Article by I. P. Khoroshilova, L. V. Ilatovskaya, G. G. Bordyugova, and F. S. Gakhramanov, Moscow Scientific Research Institute of Eye Diseases imeni Gel'mgolets]

UDC 617.7-001.37-092-07

[Abstract] Experimental trials were performed on 30 chinchilla rabbits (2-2.5 kg) with the objective of investigating the morphological aspects and pathogenesis of ocular burns caused by epichlorohydrin, which affects the cornea and iris and induces keratoiritis. The rabbits in the experimental group either received instillation of

gordox (two drops five times per day for 10 days) into the conjunctival cavity immediately following the burn or intravenous injections of gordox (0.5 ml once per day for 10 days). The clinical pattern of the burn process was studied by means of focal lighting and biomicroscopy. It was shown that epichlorohydrin burns cause a great deal of tearing, edema of the surface layers of the stroma, hyperemia, and edema of the iris. Morphologically, there is complete necrosis of the corneal epithelium, severe edema, and a complete lack of cellular elements. The results demonstrated that gordox promotes a significant decrease in the cellular infiltration of the cornea. It inhibits protease activity and the migration of cellular elements to the site of the injury by suppressing the inflammation phase in corneal tissue. It is therefore recommended for the management of epichlorohydrin burns to the eyes. However, since gordox has no effect on pathological processes in the iris, research in this direction needs to be continued. Figures 6.

### Surgical Tactics for Penetrating Gunshot Wounds of Abdomen

917C0615A Leningrad VESTNIK KHIRURGII IMENI I. I. GREKOVA in Russian Vol 146 No 3, Mar 91 pp 48-52

[Article by N. N. Gurin and V. I. Vovk, Department of Forensic Medicine, Leningrad State Institute for Continuing Education of Physicians imeni S. M. Kirov, Leningrad]

UDC 617.55-001.5-089-035

[Abstract] Reporting on the experience of treating 513 patients with gunshot wounds of the abdominal cavity, the authors present statistics on types of wounds, amount of internal bleeding, presence of shock and other factors influencing treatment selected. Immediate surgery was used in over 99 percent of cases, the only exceptions being 0.27 percent of patients who arrived in an agonal state. Ketamine narcosis was used due to its stimulating effect on the cardiovascular system. Surgery was intended to stop continuing abdominal hemorrhage and permit inspection of all intestinal organs in a standard order to assure that no injury would be missed, after which surgical treatment of the simplest type requiring the least expenditure of time was selected. The statistical materials indicate that the mortality of patients, particularly with multiple and combined wounds, was directly related to the type of surgery performed on the injured organs—death was more frequent following operations including resection of the organs and construction of anastomoses than after suturing of wounds. Access by expanding the wound is not recommended; rather, central access is preferable, providing the surgeon with greater freedom. After surgery, the abdominal cavity should be washed out with a solution of antiseptic or antibiotic, at least 4-6 l, and drained with a rubber tube. Thin tubes are then inserted to the wound sites to allow administration of antibiotics postsurgically. Surgical treatment of entry and exit wounds is performed

by the usual methods after the laparotomy. Long-term peridural anesthesia is recommended for pain relief and more rapid recovery of motor activity of the gastrointestinal tract. References 3: Russian.

#### **Regenkur Hydrogel in Topical Burn Treatment**

917C0617A Kiev *KLINICHESKAYA KHIRURGIA*  
in Russian No 3, Mar 91 (manuscript received  
13 Jun 90) pp 5-7

[Article by V. Yu. Kassin, L. I. Gerasimova, A. V. Nikolayev, A. M. Shapiro, L. I. Slutskiy, R. F. Mukhamedzhanova, A. I. Sveshnikov, L. E. Dombrovskaya and I. V. Kuzmina, Laboratory of Experimental Surgery, Chair of Operative Surgery and Topographical Anatomy, Moscow Medical Institute imeni I. M. Sechenov, Moscow Scientific Research Institute of Emergency Medicine imeni N. V. Sklifosovskiy, RSFSR Ministry of Health]

UDC 616-001.17-08

[Abstract] Therapeutic trials were conducted with freshly prepared regenkur [sic] absorbent hydrogel on 25 male and female patients with II-IIIa degree burns over 1.5-20 percent of body surface. In general, use of regenkur dressings commenced one to 10 days (four to five days average) after the insult and continued for six to 20 days (10.6 days average). This was followed by immediate alleviation of pain and over the course of hospitalization reduced 2-fold the required changes of wound dressings. Added benefits consisted of diminished bacterial contamination of the wound site and accelerated wound healing. Finally, regenkur is an inexpensive adjunct to burn therapy with the cost of seven dressings coming to 1 ruble and 34 kopecks.

#### **Impact of Absorption-Based Detoxication in Severe Burns on Cell-Mediated Vascular and Extravascular Phases of Inflammation**

917C0617B Kiev *KLINICHESKAYA KHIRURGIA*  
in Russian No 3, Mar 91 (manuscript received  
12 Dec 90) pp 7-9

[Article by G. P. Kozynets, V. P. Tsygankov, Ye. P. Nastenkov, V. M. Lositskaya, O. I. Osadchaya and A. M. Boyarskaya, Kiev Scientific Research Institute of Hematology and Blood Transfusion, Ukrainian SSR Ministry of Health; Chair of Traumatology, Orthopedics and Burns, Kiev State Institute of Advanced Training of Physicians, USSR Ministry of Health]

UDC 616-001.17-099-06-08

[Abstract] An analysis was conducted on the impact of detoxifying measures on the inflammatory process in 30 14- to 60-year-old patients with severe burns. The results were assessed in terms of neutrophil dynamics, ultrastructure, migration patterns, adhesion to endothelium and myeloperoxidase activity. On balance, the findings

demonstrated that both hemosorption and topical use of absorbents diminished vascular damage and exudation, and normalized neutrophil counts and metabolic activity. As a result, reduction in wound area was 2.8-fold greater than in control patients at equivalent time periods. References 5: Russian.

#### **Combined SHF EMF and Laser Therapy of Infected Wounds**

917C0617C Kiev *KLINICHESKAYA KHIRURGIA*  
in Russian No 3, Mar 91 (manuscript received  
22 Sep 90) pp 25-27

[Article by V. I. Lupaltsev, Yu. N. Kutafin and O. Ch. Khadzhiyev, Chair of Surgical Diseases, Pediatrics Faculty, Kharkov Medical Institute]

UDC 616-001-002.3-08:615.84

[Abstract] Comparative clinical trials were conducted on the efficacy of a combination of SHF EMF and helium-neon laser therapy in the management of 356 14- to 85-year-old patients with infected wounds (eg., surgical, varicose ulcers, etc.). The results showed that best results were obtained in the cohort managed with the SHF EMF + laser combination, this group presenting the shortest hospital stay (8.9 days). Patients treated either with SHF EMF or laser therapy had hospital stays of 10.1-10.2 days, while control patients in whom neither modality was employed were hospitalized for an average of 13.3 days. Consequently, optimum therapeutic modality was represented by antiseptic lavage of the wound site followed by 0.53-5.92 mW/m<sup>2</sup> laser therapy and 53.53 GHz SHF EMF (0.3-0.5 mW/cm<sup>2</sup>). Tables 1; references 2: Russian.

#### **Efficacy of Detoxication Efforts in Burns**

917C0617D Kiev *KLINICHESKAYA KHIRURGIA*  
in Russian No 3, Mar 91 (manuscript received  
14 Dec 90) pp 33-36

[Article by G. P. Kozynets, Chair of Orthopedics, Traumatology and Burns, Kiev State Institute of Advanced Training for Physicians, USSR Ministry of Health]

UDC 616-001.17-099-08

[Abstract] Outcome studies were conducted on 217 cases of burn trauma (severity indices 40-270 U; 2.7- to 3.3-fold elevations in serum toxicity; 30-40 percent increase in intermediate MW components) to assess the impact of detoxication efforts. The clinical results demonstrated that a combination of transfusion detoxication via dilution, extracorporeal filtration and post-hemofiltration transfusions alleviated toxicity and enhanced activities of T and B cells. The latter were reflected in an increase in E rosette-forming cells and serum IgG to 10-12 g/L two to three weeks after trauma. Detoxication was felt to be a key therapeutic factor in ensuring 100 percent survival of patients with light

burns, 87.9 percent survival of patients with burns of intermediate severity, and 55.7 percent survival of extreme cases. References 5: Russian.

### Comparative Assessment of Vascular Shunts for Hemosorption in Acute Poisoning

917C0617E Kiev *KLINICHESKAYA KHIRURGIA*  
in Russian No 3, Mar 91 (manuscript received  
17 Nov 89) pp 39-40

[Article by V. A. Trotsevich and O. V. Kurashov, Kiev Municipal Hospital for Medical Emergencies]

UDC 616-099-08:615.38

[Abstract] An analysis was conducted on 108 patients subjected to 148 vascular access procedures for purposes of hemofiltration to evaluate the clinical efficacy of Seldinger and Scribner techniques. There were 23 complications over the period of study (1987-1988), involving hematomas and inflammations at the site of access (10), puncture of femoral (6) or subclavian (3) artery, and thrombosis of shunts (2) or catheters (2). The Seldinger technique for catheterization of central veins was shown to be indicated for patients with acute poisoning, and arteriovenous Scribner shunts were indicated in exotoxic shock, renal and hepatorenal insufficiency and toxic coagulopathies. References 1: Russian.

### AIDS Chemotherapy: Results and Perspectives

917C0633A Moscow *ANTIBIOTIKI I  
KHIMIOTERAPIYA* in Russian Vol 36 No 4, Apr 91  
(manuscript received 22 Nov 89) pp 38-42

[Article by N. P. Chizhov, All-Union Scientific Research Institute of Influenza, USSR Ministry of Health, Leningrad]

UDC 616-092:612.017.1.064]-022.7:578.828.6]-085.2

[Text] Acquired immune deficiency syndrome (AIDS) is a viral infectious disease that affects the cellular immunity system, which primarily governs the population of

T-lymphocytes (T-helpers), as well as other cells of the immune (macrophages) and nervous (neuroglia) systems. In connection with its broad prevalence, unusual epidemiology, serious and prolonged course, high fatality rate, and the lack of medicines for management and prophylaxis, AIDS has become a serious public health problem. It should unequivocally be stated that an AIDS pandemic is developing in the world.

The diversity of clinical manifestations of AIDS complicates the diagnosis and the correct choice of symptomatic therapy. The malignant nature of immune system disorders makes the patient's body virtually unresponsive to medicines normally effective against the respective infections. Plasma cell pneumonia and Kaposi's sarcoma, which are most often encountered in AIDS, virtually do not yield to treatment.

According to WHO specialists, it is not currently possible to develop an effective universal vaccine against AIDS. The solution to this problem lies in a major gap in the fields of virology and immunology which will take up to 10 years to fill [39]. More than 100 companies and firms in the world are currently developing diagnostic tests for AIDS and are searching for effective preparations [11, 21]. However, in spite of the heavy research, AIDS treatment is still an unsolved problem. The complexity of solving the problem of AIDS therapy lies in the integral process of the pathogenesis of this infection; therefore, the suppression of virus reproduction in the lymphocytes or cells of the nervous system still does not mean the release of their genome from the DNA-provirus inserted into it [2].

This review is an attempt to analyze research performed on the development of etiotropic preparations against AIDS with the objective of substantiating perspectives of the solution to this problem. The search for etiotropic preparations presupposes an effect on one or several stages of human immunodeficiency virus (HIV) reproduction [7]. The search for and effectiveness of preparations against AIDS are examined based on these tenets (see Table).

Stages of HIV Replication as Points of Antiviral Preparation Application

Stage of replicative cycle	Potential inhibitors		
Antiviral preparations			
		Experimental investigation	Clinical investigation
Adsorption	Antibodies to components and receptors of target cells	CD4 peptides	
Penetration, deproteinization	Preparations that block fusion of the vibrio membrane with the plasma membrane of the cell or interfere with the “stripping” process	Chloroquine, monensin, ammonium chloride	
Transcription	Reverse transcriptase inhibitors	Foscarnet	Suramin, NRA-23, Azidothymidine (retrovir)



Stages of HIV Replication as Points of Antiviral Preparation Application (Continued)

Stage of replicative cycle	Potential inhibitors		
Antiviral preparations			
		Experimental investigation	Clinical investigation
Degradation of viral RNA in RNA-DNA hybrid	RNAase N activity inhibitors	Oligodeoxyribonucleotides	
Integration of DNA into host cell genome	Inhibition of function governed by "integrase" gene		Isoprinosine (inosiplex)
Expression of virus genes	Inhibitors of tat-III or art/trs proteins and antisense RNA	Ribavirin, D-penicillamine	
Production and assembly of virus components	Protease and protein glycosylation inhibitors or modifiers	—	—
Gemmation of virus	Interferons		Interferon preparations ( $\alpha$ -, $\beta$ -, $\gamma$ -)
Extracellular virus	Non-ionic PAV, immunotoxins	Nonoxynol-9	

#### Adsorption Inhibitors

The primary interaction of HIV with sensitive cells includes the binding of them with receptors. This stage is sensitive to the effect of specific poly- or monoclonal antibodies that react with the epitopes of enveloped virus proteins or receptor antigenic determinants of the cell.

The "Genetech" company (USA) synthesized a variant of a glycoprotein (recombinant protein CD4) present on the surface of T-helpers that performs a specific receptor role in cells reacting with HIV. The preparation hinders the binding of HIV with non-infected T-helpers [6, 41]. The preparation is currently undergoing clinical trials. In experiments *in vitro* synthetic CD4 molecules bound all free HIV vibrios and prevented their association with lymphocytes and infection of these cells. The conditions for the interaction of the CD4 molecules with the virus in the body are vague [37]. CD4-peptides with varying levels of amino acids were recently synthesized and investigated for HIV-1 reproduction. The greatest inhibiting effect was noted in peptides bearing 70-132 amino acid residues [18, 20].

It should be noted that antibodies specifically reacting with receptor structures cannot prevent the transmission of the virus from cell to cell in direct contact. The search for inhibitors at this stage of replication has been limited to experimental trials.

#### Penetration and Deproteinization Inhibitors

The penetration stage, that is, penetration of the virus into the cells, is in the early stages of HIV reproduction. The fusion of the virus sheath with the plasma membrane of the lymphocytes may play a vital role in this process. This stage can be blocked with various substances, of which calmodulin has the greatest activity among antagonists [26]. The penetration of HIV into the cell by means of endocytosis includes the stage of "stripping" the virus in the endosomes, which occurs at a low pH. Data were obtained on how the so-called inhibitors of endocytosis (chloroquine and monensin) and acidification (ammonium chloride, etc.) depress the infection activity of viruses in the T-system [30].

#### Transcription Inhibitors

A key stage in the replication of HIV is the synthesis of viral DNA on an RNA matrix with the help of the reverse transcriptase enzyme. Necessary at this stage is the search for compounds that effectively inhibit viral RNA-dependent DNA-polymerase and do not significantly affect cellular DNA-polymerase. HIV reverse transcriptase uses lysine tRNA as an initiator in the synthesis of cellular DNA. The enzyme along with the function of reverse transcription can perform the role of RNAase and destroy viral RNA in the RNA-DNA hybrid [12]. Furthermore, reverse transcriptase catalyzes the synthesis of plus DNA strands. Recent research suggests the existence of two forms of reverse transcriptase owing to the heterogeneity of HIV [3]. Reverse transcriptase is a polyfunctional enzyme bearing at least four domains that mediate RNA-dependent DNA-polymerase activity, RNAase activity, as well as a special structure for binding with nucleic acids. The end product of transcription is a linear duplex of DNA. All of these domains and the process of reverse transcription itself may be the target of inhibitors—potential chemical preparations.

A large number of reverse transcriptase inhibitors were described that can be divided into five groups: 1) substances that bind with the enzyme (suramin, NRA-23, rifampicin, etc.); 2) substances that bind with the matrix or initiator (actinomycin A, tyloron [sic], imidazole derivatives, etc.); 3) analogs of the substrate (phosphon acetate, phosphon formate, arabinosyl cytidine-5-triphosphate); 4) analogs of the matrix (2'-substituted derivatives of polynucleotides); and 5) substances that bind divalent cations (oxyphenanthromine [sic], thiosemicarbazone).

Among the numerous inhibitors of reverse transcriptase activity, four preparations are of the greatest practical interest: suramin, NRA-23, azidothymidine, and foscarnet.

Suramin (synonyms: germanin, naganol, antipol [sic]), the official anti-trypanosome preparation, is used for treating trypanosomiasis and onchocercosis. The preparation in a concentration of 50  $\mu\text{g/ml}$  suppresses the



reproduction of the HTLV-III virus [19, 31]. Suramin is able to inhibit both types of reverse transcriptases. This may be due to the preparation's high degree of affinity of protein molecules for binding with sulfonic acid residues [8]. In addition to acting on reverse transcriptase, suramin diminishes the cytopathogenic effect of the virus on OKT4+ cells cultivated together with lymphoblastoid line H9 that produces HTLV-III [28].

The results of clinical trials of suramin performed in various clinics in the USA are of undoubted interest. In one of the first investigations, the effect of suramin was investigated on AIDS patients using a procedure for management of parasitic diseases [4]. The maximum content of suramin in the sera surpassed 100 µg/ml. As a result of the treatment there was a decrease in the secretion of the virus until it completely disappeared from the sera. But several months after treatment stopped the viremia returned. There was no significant improvement in the immunological and clinical indices. The therapeutic effectiveness of suramin was tested on a representative group of patients using a longer procedure: it was administered intravenously in a dose of 0.5 g weekly for 24 weeks. The patients receiving the preparation did not exhibit clinical improvement or regression of Kaposi's sarcoma. The virus could be isolated from the blood in only six patients; the rest presented with viremia [24]. In clinical tests, 12 AIDS patients with the acute stage of HTLV-III/LAV viremia received suramin intravenously during the first three weeks in a dose of 1 g and the second three weeks in a dose of 0.5 g. Complete suppression of reverse transcriptase activity was noted in three of the 12 patients, with a decrease in its level noted in two patients. A decrease in the clinical manifestations of the disease was objectively found in one patient. We did not see a significant effect of the preparation on the immune status. The appearance of opportunistic infections was noted in seven patients [27]. Similar results were obtained in the intravenous use of suramin in doses of 0.5 or 1 g in 19 AIDS patients [29]. In research conducted on a small group of AIDS patients, we observed visible improvement in the clinical and immunological manifestation of infection after treatment with suramin [17]. Toxicity of the preparation in the way of elevated temperature and renal and hepatic dysfunction was noted. We did not reach a final conclusion on the therapeutic effectiveness of suramin on AIDS. We may recommend this preparation as a prophylactic agent for individuals who have been in contact with AIDS patients. Considering the toxicity of suramin, it should be prescribed with caution.

NRA-23 (antimony tungstate) is a complex inorganic compound containing ammonium, tungsten, and antimony. NRA-23 elicits competitive inhibition of HIV-1 reverse transcriptase which does not significantly affect the cell population [19]. The maximum permissible amount of this preparation with respect to HIV revertase is 100 µg/ml [8].

Clinical trials of NRA-23 were performed first on a limited contingent of patients. The preparation was prescribed intravenously in the form of two courses with a 1.5 month

interval between them. NRA-23 was administered in a dose of 0.2 g for 15 days per course of treatment. One year after treatment the development of opportunistic infections was not noted or they did not progress [10]. At the same time, trials on NRA-23 performed in France and the USA on a total of 130 patients did not demonstrate any significant effectiveness of the preparation [32]. The preparation did not penetrate the blood-brain barrier or suppress bone marrow function, which is expressed in thrombocytopenia [31]. Finally, significant suppression of reverse transcriptase activity in AIDS patients that daily received NRA-23 was observed in cell cultures in 63 percent of cases [10].

#### Azidothymidine (zidovudine, zidovir)

3'-azido-3'-deoxythymidine, was first synthesized in the USA in 1968. Its high inhibiting activity with respect to murine C-type retroviruses was identified. In concentrations that do not affect the development of normal T-cells, azidothymidine suppresses the replication and cytopathogenic effect of different variants of HIV [1, 15]. The mechanism of the effect of azidothymidine on HIV reproduction has been thoroughly studied [14]. The preparation is metabolized in cells to mono-, di-, and triphosphate derivatives. Azidothymidine 5'-triphosphate competes with thymidine-5'-triphosphate, thus inhibiting the function of reverse transcriptase at the level of lengthening the DNA chain and thus blocking the synthesis of viral DNA [29]. Azidothymidine is 100 times more active against HIV reverse transcriptase than against the DNA-polymerase of mammalian cells [25].

Clinical trials on azidothymidine have been performed since 1985. Sufficient tolerance of the preparation in peroral administrations in a dose of 100 mg every four hours has been noted. Azidothymidine penetrates the blood-brain barrier well. The side effects of the preparation are the infrequent pronounced anemia and neutropenia [5, 22]. In a double blind controlled experiment, the effectiveness of azidothymidine for treating AIDS patients was investigated. In the experimental group of 140 patients treated with the preparation, only one died. At the same time in the control group, 19 of 40 died. Significant improvement in the clinical course of the disease and stabilization of the immune status were observed in the patients treated. The effect of treatment was noted within two weeks after treatment started [13]. The differences between the groups were reliable ( $p < 0.001$ ). In the AIDS patients that received azidothymidine, an increase in T4 cells was observed, and then substantial differences between the experimental and control groups for this index were not found. The level of the HIV-antigen dropped in the process of treatment in patients in comparison with the control group [23]. When azidothymidine was administered intravenously for two weeks or orally for four weeks, the therapeutic level of the blood concentration of the preparation was 5 and 10 mg/ml, respectively. An analysis of two years' (1985-1987) of clinical trials on zidovudine in the USA for the treatment of AIDS patients is presented. Of 3,247 patients that received the preparation, 97 died, among

whom 21 had taken the preparation for more than three weeks. Among the patients that took zidovudine continuously for 18 months, there was a decline in neurological complications in the form of neuropathy and dementia. Under conditions of the prolonged use of the preparation, a side effect in the form of anemia related to suppression of bone marrow, headaches, nausea, and vomiting was noted in 25 percent of patients [6]. Azidothymidine increases the survival rate among AIDS patients for one year from 15 to 50 percent [9]. The firm "Wellcome" (Great Britain) began the commercial production of azidothymidine under the name "retrovir". The preparation may be recommended for treating AIDS patients with plasma cell pneumonia complications. The preparation is administered to adult patients orally in a dose of 200 mg every four hours or intravenously in a dose of 1.5 mg/kg every four or eight hours. With the advent of anemia the dose of the preparation is diminished or treatment stops [20]. The synthesis of a large number of derivatives of 2', 3'-dideoxynucleosides is currently being described and their antiviral activity is being studied [25, 34]. Among the analogs, 3'-azido-2',3'-dideoxyuridine (CS-87) markedly inhibits HIV-1. The preparation is less toxic than azidothymidine. Clinical trials are currently underway.

Foscarnet (phosphon formate, phosphonoformic acid, PFA) is an anti-herpes preparation. It inhibits reverse transcriptase activity and suppresses the cytopathogenic effect of HTLV-III [35]. The maximum permissible amount of foscarnet with respect to HIV reverse transcriptase is 5  $\mu$ M. In a concentration that is non-toxic to cells (680  $\mu$ M) the preparation completely suppresses revertase activity and eliminates the virus in a culture of infected H-9 cells [3]. A synergistic effect of foscarnet on HIV replication in a culture of human lymphocytes is noted in combination with  $\alpha$ -interferon in a dose of 16-64 U/ml [16]. Twenty-six analogs of foscarnet have been synthesized and the inhibiting activity with respect to HTLV-III revertase has been studied [38]. Inhibitors more active than foscarnet were not found.

The first results of foscarnet treatment for AIDS and AIDS-related complex patients were obtained in Europe [36]. The preparation does not penetrate the blood-brain barrier and its chief shortcoming is nephrotoxicity.

#### RNAase H Activity Inhibitors

The use of synthetic oligodeoxyribonucleotides complementary to the conservative sections of the HIV genome is a peculiar approach to the development of medicines for the etiotropic therapy of AIDS. In contrast to the great mutability of the HIV envelop protein, the nucleotide sequence of the regulatory sections of the virus genome is highly conservative in different variants and strains of HIV. In this case, "hybridization competitors" or "hybridons" (antisense RNA) can effectively simulate replication, transcription, or translation of the virus. Oligodeoxyribonucleotides, complementary to the homologous binding site for the HIV RNA initiation for lysine tRNA as well as other sections of the HIV genome,

inhibit the expression of the reverse transcriptase gene and other genes, decrease the level of p15 and p24 protein synthesis, and suppress the replication of HIV in cell cultures. It is estimated that 20  $\mu$ M in an extracellular medium and 1.55  $\mu$ M in an internal membrane of the cell should be an effective inhibiting concentration of oligonucleotides for expression of "competition in hybridization" [16]. These data indicate the possibility of directed selection of oligonucleotides as highly effective HIV inhibitors. The oligodeoxynucleotides protected from nucleases by being in liposomes may be used as medicinal agents against AIDS [31].

#### DNA Integration Inhibitors

Isoprinosine, an immune response modifier, apparently acts at the stage of DNA integration into the host-cell genome.

Isoprinosine (inosiplex, methisoprinol) has been studied for AIDS therapy since 1985. The first investigations were performed on lymphocytes isolated from patients with clinically expressed forms of AIDS, as well as those in the prodromal stage of the disease. It was demonstrated that isoprinosine stimulates the production of interleukin-2, the expression of the tat-antigen, and the activity of natural killers [3]. Isoprinosine in a concentration of 100  $\mu$ g/ml completely normalized the function of lymphocytes obtained from patients in the prodromal stage of the disease. At the same time lymphocyte function under the influence of isoprinosine in 11 (47.8 percent) of 23 AIDS patients in serious condition was restored only partially [19]. Comparative clinical trials of isoprinosine in patients in the prodromal stage of the disease with patients clinically expressed AIDS revealed the great effectiveness of the preparation in the first group of patients [15]. Administering isoprinosine in a dose of 4 g per day for four weeks increased the proliferative reaction of the lymphocytes in AIDS patients in the early stages of the disease [15]. The preparation is most effective in the prodromal period and in the early stages of the disease.

#### Translation Inhibitors

Among the preparations that act at this stage of translating the HIV gene, the chemical preparation ribavirin (virazole) should be mentioned. It is an antiviral preparation with a wide spectrum of action that is used for treating respiratory syncytial infections in children and some viral hemorrhagic fevers [33]. Ribavirin in a concentration of 50  $\mu$ g/ml inhibits the replication of lymphadenovirus-associated virus in a culture of human T-lymphocytes [4]. Similar results were obtained in the use of the HTLV-III retrovirus in an H9 culture. Ribamidil (USSR) suppresses the reproduction of HTLV-III [1].

Clinical trials on ribavirin in AIDS treatment began in 1986. The effect of ribavirin on reverse transcriptase activity in the plasma was investigated in a group of HIV-positive homosexuals with generalized adenopathy. The preparation was administered orally in a dose of 1,200-2,400 mg per day for two weeks or in a dose of 2,400 mg per day for three days with a subsequent decrease in the dose to 600 mg per day for four weeks. In

most of the patients the preparation reduced the level of reductase activity. However, T4+ cells dropped to baseline in only three patients [32]. Ribavirin may be recommended as the medicine of choice in preventing generalized infection in HIV positive patients at the beginning of clinical manifestations of the disease. In phase I of the disease ribavirin is administered orally in a daily dose of 600 mg [33].

D-penicillamine (trovol [sic]) is an amino acid analog of cysteine and valine. It is an active inhibitor of HTLV-III/LAV virus replication. The complete inhibition of virus replication is noted in concentrations of 49 µg/ml, while a cytotoxic effect of the compound is noted at a dose of 500 µg/ml [4]. The mechanism of the effect of this substance is investigated with the use of monoclonal antibodies. It was found that D-penicillamine inhibits the expression of proteins p15 and p24. The isomer L-penicillamine has a similar effect. D-penicillamine was tested on patients with generalized adenopathy. Peroral administration of the preparation in a dose of 1-2 g per day diminished virus reproduction in 60 percent of patients [4]. The treatment of patients with an asymptomatic infection resulted in a substantial decrease in the T4/T8 ratio. A reversible decrease in the lymph nodes, and a decrease in the number of lymphocytes and the T-cell lymphoproliferative response were observed in most patients. In all patients that received the course of treatment for at least two weeks there was suppression of HIV replication. The authors conclude that D-penicillamine is an effective preparation that inhibits the expression of the HIV gene [4].

### Interferons

The interferon system is actively involved in the pathological process that occurs in AIDS. An unusual acid-labile form of  $\alpha$ -interferon is found in the blood of the overwhelming majority of AIDS and lymphadenopathy patients. This, in the opinion of a number of authors, may be viewed as a prognostically adverse indicator [25, 32]. It has not been established whether HIV stimulates the production of interferon itself [23].

Currently, there are ambiguous reports in published literature on the experimental and clinical trials of interferon. The effect of human interferons of various origin on the replication of HIV variants (Arv-2, LAV, HTLV-III) in primary cultures of peripheral blood lymphocytes has been studied [3]. The addition of  $\alpha$ -interferon to the maintenance culture in a concentration of 100 U/ml decreased the production of HIV by 50 percent. With the repeated addition of  $\alpha$ -interferon to the cell culture, the complete suppression of HIV reproduction was noted with the use of the preparation in a concentration of 256 U/ml [40]. Fibroblast interferon in a dose of 100 U/ml inhibited the production of HIV by 75 percent. Immune interferon did not have a significant effect on HIV reproduction [41]. The natural leukocytic interferon was almost 2-fold more effective than recombinant  $\alpha$ -interferon [41]. The results of clinical testing indicate the ability of interferons to induce regression of

Kaposi's sarcoma, but do not improve the immunological indices in AIDS patients [41]. Improvement in the regression of Kaposi's sarcoma is apparently due to the anti-proliferative activity of interferon. At the same time even large doses of the interferon preparations do not suppress HIV replication [41]. Comparative evaluation of recombinant  $\alpha$ - and  $\gamma$ -interferons in patients with serious forms of AIDS confirm this [41]. At the same time a synergistic effect of  $\beta$ -interferon (betaseron [sic]) and azidothymidine on the course of an opportunistic infection in AIDS patients was found [38]. The use of  $\gamma$ -interferon in AIDS patients (II phase) did not have a significant effect on the course of the infection [38]. And finally, it should be noted that the effectiveness of some interferon inducers against HIV-1 has been experimentally demonstrated: the double-stranded replicative form of RNA, a stabilized complex of poly (I) x poly(Ts) (ampligen) [24].

Extracellular virus inhibitors in principle may be used in AIDS chemotherapy. Although they do not affect the intimate processes involved with HIV reproduction in virus-infected cells, they can suppress antigenemia due to neutralization of the extracellular virus. Nonoxynol-9 may be used as an example. This non-ionic surfactant is an ingredient in some spermicides and inactivates HTLV-III *in vitro* [19]. This preparation inactivates HIV in sperm.

The search for substances that destroy cells infected with the HIV virus and that eliminate them from the body are some non-traditional directions in the development of preparations against AIDS. Recently a group of Japanese scientists from the University of Kumamoto produced an immunotoxin based on monoclonal antibodies to protein gp120 of the HIV gag gene in combination with a growth toxin. Treatment with the immunotoxin results in death of the HIV-1 infected cells [22].

### Conclusion

The data presented suggest primarily that within a very short time a large number of natural and synthetic preparations with various mechanisms of action have been experimentally and clinically studied. Based on investigation of the molecular and biological mechanisms of HIV replication, etiotropic preparations have been found, the basis of the mechanism of action of which is inhibition of one and/or several stages of HIV reproduction. The discovery of inhibitors of HIV reverse transcriptase activity is one of the undoubted achievements of the development of this direction of research. Azidothymidine, which is manufactured in the USA and Great Britain, is the most effective and clinically promising preparation with this mechanism of action. The greatest specificity of reverse transcriptase inhibitors may be achieved by finding preparations that inhibit reverse transcription due to interaction with substrates. Moreover, the search for novel inhibitors of the enzyme should be conducted using a highly purified enzyme with comparative assessment for homologous cellular

enzymes of  $\alpha$ -,  $\beta$ -, and  $\gamma$ - [33]. The use of oligodeoxyribonucleotides, inhibitors of donor or acceptor sections of HIV splicing, is very promising. The HIV genome, along with standard genes which also exist in other retroviruses, contains additional genes that play a key role in virus replication in T-cells. The product of each of these genes may be viewed as a target for the development of novel inhibitors. In connection with this, some poorly studied stages of HIV replication hold promise for the development of highly specific chemical preparations with directed action. Considering recent advances in the molecular biology of HIV, some of them should be noted: the search for inhibitors that modify the C-terminal fragment of the transmembrane protein (gp41) and blocking of self-regulation of virus replication by proteins that are coded by the tat-III or art genes [27]. However, we need to clearly understand that the integrative nature of infection in AIDS significantly complicates the possibility of complete elimination of HIV from the body. Therefore, the use of etiotropic preparations needs to be combined with other pathogenetic agents. A complex approach that considers the stage of development of the disease should underlie the current approach in the prophylaxis and treatment of AIDS. We do not doubt that the greatest success in treatment is determined by the use of etiotropic preparations at the early stages of the disease, as well as among individuals at greater risk. The entire complex of current medicines should be used during the height of the disease and the respective manifestation infections.

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#### **Results of Surgical Treatment of Renal Carcinoma in High Surgical Risk Patients With Hyperbaric Oxygenation**

917C0635A Moscow *SOVETSKAYA MEDITSINA* in Russian No 3, Mar 91 pp 27-29

[Article by L. L. Volpyan, Yu. G. Alyayev and M. A. Yushkov, Moscow Medical Academy imeni I. M. Sechenov]

UDC 616.61-006.6-089.166:615.835.3[-089.168-07

[Abstract] The desire to provide high-risk surgical patients with adequate surgical treatment for renal carcinoma stimulated the authors to seek means to decrease the surgical risk. The use of hyperbaric oxygenation increases the oxygen content of arterial blood and of the tissues, preventing hypoxia and acidosis and increasing the resistance of the organism to surgical trauma and loss of blood. This article reports on the experience of surgery on 56 patients with renal carcinoma whose condition did not allow surgery under normal conditions. Indications for hyperbaric oxygenation during surgery of this type are listed. The most suitable method is to begin hyperbaric oxygenation immediately before the most traumatic stage of the operation, involving the greatest blood loss. Patients showed a significantly smaller increase in

the level of lactic acid in the blood after surgery than patients operated on under normal oxygen pressure. Five of the patients died, one during surgery and four post-surgically. Complications included pneumonia in three patients, eventration of the small intestine in one, parapancreatic abscess in one, renal insufficiency in three. References 7: 5 Russian, 2 Western.

#### **Monoclonal Antibody to Human B-Lymphocyte Antigen With Molecular Mass 45 kD**

917C0638A Kiev *EKSPERIMENTALNAYA ONKOLOGIYA* in Russian Vol 13 No 1, Jan-Feb 91 pp 45-58

[Article by A. V. Filatov, N. A. Markova and S. I. Zadorozhnyy, Institute of Immunology, Ministry of Public Health, USSR, Moscow]

UDC 616-006.446-097

[Abstract] Appearing and disappearing at certain stages of development of lymphocytes, differentiating antigens are convenient markers for phenotyping of cells in lymphoproliferative diseases. The discovery of new antigens facilitates still more precise diagnosis of lymphoma and leukemia. This article reports on the development of the monoclonal antibody 3F3, in subclass IgG2b, which reacts with 7 percent of mononuclear cells in human blood. It is concluded that 3F3 reacts exclusively with B-lymphocytes. The 3F3 antigen is expressed on mature B-cells and disappears from the cell surface upon their activation. The molecular weight of 3F3 is 45 kD. Its expression correlates well with the expression of B-cell antigens CD19, CD21 and CD22. Figures 2; references 10: 2 Russian, 8 Western.

#### **Morphological Description of Hypophyseal-Gonadal System Under Conditions of High-Altitude Hypoxia**

917C0646B Moscow *BYULLETEN EKSPERIMENTALNOY BIOLOGII I MEDITSINY* in Russian No 4, Apr 91 (manuscript received 22 Jun 90) pp 432-436

[Article by O. K. Khmelnitskiy and T. Ya. Tararak, Chair of Pathological Anatomy, Leningrad Institute for the Advanced Training of Physicians imeni S. M. Kirov; Central Scientific Research Laboratory, Kirghiz Medical Institute, Frunze]

UDC 612.432+612.617].06:612.275].086

[Abstract] The objective of this study was to investigate the interaction of the hypophyseal-gonadal system in mongrel pubertal male rats at high altitude (3,200 m). The changes observed in the animals living at this altitude for one to three days were characterized by structural alterations in the gonadotropic cells of the hypophysis. Light microscopy did not reveal any significant structural changes, but other



alterations indicated diminished active transport of substances into the cell and disturbance of the barrier function. Changes in the tissues of rats sacrificed after seven to 15 days at high altitude included an increase in the volume of most gonadotropic cells in the hypophysis. Overall, the authors noted signs of synthesis activation in the gonadotropic cells as well as increased hormone secretion into the vascular bed and diminished testicle mass. At 30 days the hypophyseal gonadotropocytes are functional, but show signs of less secretion, and at 60 days the authors observed a slight trend towards reparation of impaired structures. The results demonstrated that a sojourn at high altitude alters the functional relationships between the gonadotropic cells of the hypophysis and testicles as characterized by changes in the synthesizing function of the gonadotropocytes and the process by which they secrete the hormone and impairment in the barrier function and active transport in the sustentocytes of the testicles. The data also showed that the diminished hormone-producing function of the glandulocytes was not compensated by an increase in the number of cells of Leydig, which in turn exacerbated the disharmony in the hypophyseal-gonadal system. By the end of the second month the researchers noted that the animals' bodies adapted to the change by inhibiting hormone secretion by the gonadotropic cells while maintaining a high level of synthesis. Figures 2; references 18: 14 Russian, 4 Western.

**Millimeter Range Electromagnetic Oscillation Stimulation of Reparative Osteogenesis in Experimental Trauma Injuries to Lower Jaw**

917C0646C Moscow BYULLETEN  
EKSPERIMENTALNOY BIOLOGII I MEDITSINY  
in Russian No 4, Apr 91 (manuscript received  
13 Jul 89) pp 436-439

[Article by Ch. R. Ragimov, G. P. Ter-Asaturov, M. B. Golant, K. A. Rogov, and L. Z. Balakireva, First Moscow Medical Institute imeni I. M. Sechenov]

UDC 615.849

[Abstract] The objective of this study was to investigate the effect of electromagnetic oscillations of non-thermal intensity on the processes of reparative regeneration in lower jaw bones and the tissue surrounding the injury in 60 chinchilla rabbits (2.2-2.5 kg). The skin in the subjects was cut to the bone and a hole 6 mm wide was made. The animals were then irradiated with 5-6 mm wavelength electromagnetic radiation for 0.5 to one hour for seven sessions over the course of two weeks. Tissue samples taken at seven-day intervals showed that the experimental group exhibited greater connective tissue and osteoid formation that was vascularized more quickly. X-ray morphology data demonstrated that electromagnetic radiation at this wavelength stimulates the reparative regeneration of bone tissue in the lower jaw, with the one-hour sessions shown to be more effective than the 0.5 hour sessions. This method of treatment is recommended for the management of injuries to facial bones. However, further research is still

needed since the mechanism of reparation remains vague. Figures 2; references 6: Russian.

**Lensectomy in High Myopia**

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in Russian Vol 107 No 2, Mar-Apr 91 (manuscript  
received 1 Mar 90) pp 18-20

[Article by A. V. Svirin, D. O. Kolesnikov and Abdul Karim Khasam, Chair of Eye Diseases, Therapeutics Faculty, 2nd Moscow Medical Institute imeni N. I. Pirogov]

UDC 617.753.29-089:617.741-089.87

[Abstract] cursory details are provided on a successful approach to lensectomy in older patients (40-55 years) with high myopia (16.0-23.0 diopters, preoperative visual acuity with correction 0.1-0.4). The essential features consist of preliminary intracapsular Nd-YAG laser emulsification of lenticular fibrils two to four days before lensectomy. The subsequent stages involved Nd-YAG laser anterior capsulotomy and lens extraction via two small (2.5 mm) corneal incisions at 11 and seven o'clock. Observations on 23 patients (44 eyes) showed that there were no complications, the duration of postsurgical hospitalization was three to four days, and visual acuity improved 2- to 3-fold with correction and ca. 13-fold without. Tables 1; references 7: 5 Russian, 2 Western.

**Effects of Magnetic Induction on Bacterial Wound Contamination in Children**

917C0668A Baku AZERBAYDZHANSKIY  
MEDITSINSKIY ZHURNAL in Russian No 10,  
Oct 90 pp 12-16

[Article by A. O. Azizbekov, A. M. Mustafayev and G. G. Ibragimov, Chairs of Pediatric Surgery and of Microbiology, Virology and Immunology, Order of the Red Banner of Labor Azerbaijan State Medical Institute imeni N. Narimanov]

UDC 616-001.17/4:616-022.7:615.847.8

[Abstract] Bacteriologic studies were conducted on superficial and severe burns in 45 children (three months to 14 years) to assess the efficacy of magnetotherapy in controlling bacterial wound contamination. Studies on superficial lesions and deep wounds showed that the mean level of contamination in the former was on the order of  $10^4$ - $10^5$  bacteria/g of tissues, and  $10^7$  bacteria/g in the latter. Approximately 64 percent of the isolates were Gram negative. In addition to objective and subjective clinical improvements, magnetotherapy was also shown to reduce bacterial counts. The counts were reduced to  $10^3$  bacteria/g after three to five magnetotherapy treatments in superficial burns. In children with deep burns seven to 10 magnetotherapy sessions were required for a similar degree of reduction; in addition, the time to skin surgery was reduced by 15.8 days. Tables 2; references 8: Russian.

**Clinical and Epidemiological Aspects of Powassan Encephalitis in Southern Soviet Far East**

917C0606A Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian No 3, Mar 91 (manuscript received 31 Oct 89; after revision 15 Apr 90) pp 35-39

[Article by G. N. Leonova, M. N. Sorokina, and S. P. Kruglyak, Epidemiology and Microbiology Scientific Research Institute, Siberian Department, USSR Academy of Medical Sciences, Vladivostok]

UDC 616.831-002-022.7:578.833.26]-07

[Abstract] This communication focuses on the results of the clinical and epidemiological analysis of 14 confirmed cases of Powassan encephalitis virus infection that occurred in Primorsk Kray between 1973 and 1989. The Powassan encephalitis virus is transmitted by tick bites in forested areas and has a two- to 14-day incubation period with sudden onset of illness. The results indicate that the infection may be accompanied by cerebral and meningeal lesions or fever, or symptoms may be absent. The vestibulo-cerebellar lesions found in Powassan encephalitis virus infection are distinct from those that occur with tick-borne encephalitis. Asymptomatic and febrile forms of this infection apparently are frequently undiagnosed, while encephalitis and meningeal forms are quite rare. In addition, the fact that Powassan encephalitis infects mainly young children and the elderly suggests that it is less virulent than tick-borne encephalitis. Finally, the results also demonstrated that mixed infections of tick-borne encephalitis, Powassan encephalitis, and Lyme disease are possible. Tables 2; references 14: 10 Russian, 4 Western.

**Immunologic Status Indices in Monkeys Immunized With Meningococcus B-Vaccine**

917C0606B Moscow *ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII* in Russian No 3, Mar 91 (manuscript received 10 Jan 90) pp 41-44

[Article by L. I. Krasnoproshina, T. V. Kildyushevskaya, T. A. Serova, T. A. Chulok, E. K. Dzhikidze, Ye. Ya. Balayeva, N. T. Yakovleva, A. P. Alliluyev, O. V. Kotelnikova, A. B. Petrov, and V. G. Goloborodko, Vaccines and Sera Institute imeni I. I. Mechnikova, USSR Academy of Sciences; Epidemiology and Microbiology Scientific Research Institute imeni N. G. Gubricheskiy, RSFSR Ministry of Health, Moscow; Experimental Pathology and Therapy Institute, USSR Academy of Medical Sciences, Sukhumi]

UDC 615.371:579.861.1].015.48:612.017.1

[Abstract] The objective of this investigation was to develop a method for assaying for bactericidal antibodies to meningococcus group B. Experimental trials were performed by vaccinating 24 rhesus macaque monkeys with doses ranging from 25 to 100 µg per vaccination to evaluate the immunogenicity of the Soviet protein B-polysaccharide vaccine. The results of the bactericidal test demonstrated that the protein B-polysaccharide vaccine expressed excellent immunogenic activity. The bactericidal antibody level was 4-fold higher in 93.3 percent of vaccinated animals three weeks after the first immunization, and 8- to 10-fold higher two weeks after the second immunization. In addition, it was shown that the level and dynamics of bacteriolysin accumulation and the increase in the antibody titer to the meningococcus protein antigen were dependent on the vaccine dose and the number of immunizations. Immunization of the monkeys with the protein B-polysaccharide vaccine did not stimulate cytotoxic anti-cerebral antibodies, as evidenced by the fact that no significant differences were noted in the migration of glia under the influence of monkey sera obtained before and after immunization. These results indicate that the vaccine is non-toxic. Tables 2; references 12: 7 Russian, 5 Western.

**Microbial Flora of Bark Compost**

917C0611A Kiev *MIKROBIOLOGICHESKIY ZHURNAL* in Russian Vol 53 No 2, Mar-Apr 91 (manuscript received 23 Oct 90) pp 9-11

[Article by I. A. Ellanskaya, V. A. Zakharchenko, L. A. Grishkova, Ye. V. Sokolova, A. T. Shkolnyy and T. I. Bilay (dec), Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev; Forest Engineering Academy, Leningrad]

UDC 582.288

[Abstract] A mycological survey was conducted at pulp and paper mills across the USSR to assess fungi involved in hardwood and conifer bark composting. The six year study (1983-1989) led to the isolation of 1000 fungal cultures identified as falling into five classes (Oomycetes, Zygomycetes, Ascomycetes, Deuteromycetes, Basidiomycetes), 51 genera, 115 species and four varieties. Mesophilic fungi were found to be responsible for the initial attack on bark components, whereas the thermophilic and thermotolerance fungi were responsible for the final stages of biodegradation and biotransformation. Tables 1; references 10: 2 Russian, 8 Western.

**Testing Quaternary Ammonium Compounds  
Against Phytopathogenic Bacteria**

917C0611B Kiev *MIKROBIOLOGICHESKIY  
ZHURNAL in Russian* Vol 53 No 2, Mar-Apr 91  
(manuscript received 30 Mar 89) pp 55-59

[Article by A. K. Vakulenko, M. D. Kulikovskaya, G. A. Golik and M. O. Lozinskiy, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev]

UDC 632.934.3.631.53.01

[Abstract] Seven quaternary ammonium compounds were screened for efficacy against phytopathogenic bacteria, using disk diffusion and serial dilution methods. Efficacy was assessed in relation to 80 percent tetramethylthiuram disulfide (TMTD) solution. In terms of bacteriostatic and bacteriocidal activities compound No 3, otherwise unidentified, exceeded TMTD in antibacterial potency and was thus identified as a promising agent for further evaluation. In addition, compound No 3 also stimulated winter wheat growth and development. Figures 1; tables 2; references 8: 6 Russian, 2 Western.

**Microbial Adhesion to Metal-Doped  
Carbon-Based Absorbents**

917C0611C Kiev *MIKROBIOLOGICHESKIY  
ZHURNAL in Russian* Vol 53 No 2, Mar-Apr 91  
(manuscript received 27 Jul 90) pp 98-103

[Article by A. V. Grigoryev, V. A. Znamenskiy, V. I. Bugayev, M. Ye. Shor-Chudnovskiy and N. T. Kartel, Kiev Institute of Advanced Training for Physicians]

UDC 615.246.2:546.26:576.524:579

[Abstract] Carbon-based absorbent materials used in clinical practice were treated with metal ions to assess the impact of such modification on bacterial adhesion and inactivation. Trials with KAU-1 and SKN-1 showed that doping with Cu and Zn ions to a surface concentration of 0.025-2.5 meq/g affected adhesion of *Escherichia coli* 41, *Pseudomonas aeruginosa* 103 and *Staphylococcus aureus* 209. The modified absorbents were uniformly bactericidal—unlike unmodified materials—and, in general, adhesiveness was enhanced. In vivo studies confirmed that the metal ion-doped materials were nontoxic, while enhanced absorption of pathogenic bacteria and their toxin and bactericidal properties minimized the risk of tissue infection. Tables 1; references 4: Russian.

**Functional Status of the Body of Helicopter Pilots Flying in a Hot Climate***917C0567A Tashkent MEDITSINSKIY ZHURNAL UZBEKISTANA in Russian No 11, Nov 90 pp 38-39*

[Article by A. A. Bochenkov, V. A. Chvyakin, Order of Lenin Red Banner Military Medical Academy imeni S. M. Kirov]

UDC 613.1:612.014.43

[Text] Flights of crews in modern helicopters in regions with a hot climate produce considerable stress on the functional systems of the body, especially in emergency conditions (during the aftermath of natural disasters). The use of helicopter aviation has turned out to be more effective in such conditions. Over most of the southern part of the Soviet Union (Central Asia, the Caspian Sea coast, central Georgia, Armenia), air temperature in the summer often exceeds 35°C.

When the intensity of the work done by helicopter pilots is increased in a hot climate, their functional status must be assessed from the standpoint of job reliability. That is especially urgent in the development of the concept of the job-related health of a flight crew (V. A. Ponomarenko, 1986, 1987). A total of 91 helicopter pilots were examined. The functional status of the body was determined from the activity of succinate dehydrogenase (SDH) of blood lymphocytes in the context of R. P. Nartsisov's method (1970) and from excretion of electrolytes and protein in the urine. Before and after the flights, the pilots were examined in a preflight medical-examination chamber, and the Robinson index (myocardial oxygen consumption) was calculated. Job efficiency was assessed from data obtained with objective monitoring equipment (SARPP-12 D) upon landing. Pilots with a total of 2,000 hours or more of flying time exhibited a consistent decline in SDH activity of lymphocytes and pH of urine before and after the flights in a hot climate, as well as an increase in the excretion of calcium and magnesium with the urine and a decrease in the sodium-to-potassium ratio.

Some interesting dynamics associated with total flying time are found in the analysis of the changes in physiological indices. After 1,000 hours flying time, as more hours are logged in, the pulse rate increases and systolic and diastolic pressure rise. After the flights, the diastolic pressure increases only after the 2,000-hour mark is reached. As flying time increases, parasympathicotonia and the Robinson index rise.

In pilots with the highest flight loads (an average of 252 minutes per flight shift), SDH activity before the flight was lower than in pilots with the lowest flight loads (an average of 84 minutes). Intensive flight activity amidst unfavorable flight factors lowers the SDH activity.

Protein was found in the urine in 21 percent of the pilots after the flights, and the crew commanders, whose job has more emotional stress, exhibited a higher frequency

of proteinuria than did the navigators (12.2 percent and 8.8 percent, respectively). Comparison of the indices of functional status of the body in the pilots demonstrated a number of differences.

For example, before a flight, the pilots with proteinuria exhibited consistently lower SDH activity and excretion of sodium and calcium with the urine. A tendency toward elevated autonomic function activity was noted. After the flights, during the recovery period, in the pilots with proteinuria, excretion of potassium, calcium, and inorganic phosphorus with the urine remain consistently lower than in pilots without proteinuria; SDH activity became virtually identical. Differences in physiological indices in the pilots of the two groups were less pronounced than before a flight.

The worsening of the functional status of the body of pilots with proteinuria was accompanied by a consistent decline in job efficiency. The time spent actively working the collective pitch stick during a landing was 16 percent greater than in pilots without proteinuria. That also makes it possible to conclude that proteinuria after flights is a sign of the worsening of the functional status of the body of helicopter pilots.

The time spent actively working the collective pitch stick reflects not only the job efficiency, but also the degree of emotional stress the pilots underwent in flight. An increase in the time spent actively working the collective pitch stick was accompanied by a consistently higher Robinson index after the flights.

Thus, the dynamics of the indices studied as a function of total flying time and magnitude of flight load in the course of a flight shift convincingly describes the main sign of job-related health—the ability to restore the working status in relation to the volume and type of occupational labor.

**Assessing the Information Value of Symptoms in Acute Poisonings With Phosphororganic Pesticides***917C0567B Tashkent MEDITSINSKIY ZHURNAL UZBEKISTANA in Russian No 11, Nov 90 [manuscript received 29 Mar 89] pp 45-47*

[Article by A. I. Iskandarov, Central Asian Medical Pediatric Institute]

UDC 613.632

[Text] Poisoning with phosphororganic pesticides (POP) is one of the leading chemical traumas.

We decided to determine the quantitative content of each clinical symptom in poisonings associated with the more widely used POPs (carbofos, chlorofos, and BI-58) and to study the relationship of clinical and morphological changes to initial magnitude of chemical trauma.

The material for the research was an analysis of 104 conclusions of forensic medicine studies of fatal POP poisonings, plus clinical observations of 92 individuals with acute poisonings with phosphororganic compounds.

The qualitative and quantitative blood content of phosphororganic compounds were determined on the Tsvet-100 domestic gas chromatograph, which has a selective thermionic detector. Cholinesterase activity in whole blood was determined with Khestrin colorimetry.

In evaluating information value, we determined the weight and rank of symptoms. The weight of a symptom was designated by a number proportional to the magnitude of prognosis error associated with an outcome in the event if the symptom had not been considered.<sup>2</sup> Rank indicated the position of the symptom in terms of relative information value.

All the calculations were done on a YeS-1020 computer with a special algorithm<sup>1</sup> in the All-Union Center for Treatment of Acute Poisonings of the Scientific Research Institute of Emergency Care imeni N. V. Sklifosovskiy.

It was established that specific symptoms of a given type differ in initial magnitude of chemical trauma, depending on the POP (Table 1). For example, bronchorrhea, myofibrillation, and retarded conductivity of the contractive myocardium were recorded in carbofos poisoning with an initial content of poison in the blood of  $1.51 \pm 0.17$ ,  $1.15 \pm 0.11$ , and  $0.73 \pm 0.09$   $\mu\text{g/ml}$ . Concentration thresholds in damage by chlorofos are considerably higher:  $3.22 \pm 0.61$ ,  $2.09 \pm 0.37$ , and  $1.67 \pm 0.30$   $\text{mg/ml}$  ( $P < 0.01$ ). A similar relationship was found with morphological research: the concentration threshold for death was  $1.61 \pm 0.16$  for carbofos and  $4.60 \pm 1.03$   $\text{mg/ml}$  for chlorofos ( $P < 0.01$ ).

# Clinical and Morphological Symptoms of Carbofos and Chlorofos Poisonings as a Function of Initial Magnitude of Chemical Trauma

Symptom	Carbofos		Chlorofos	
	Poison content, $\mu\text{g/ml}$	Cholinesterase activity, % of norm	Poison content, $\mu\text{g/ml}$	Cholinesterase activity, % of norm
Vomiting	$1.03 \pm 0.29$	$24.4 \pm 2.66$	$1.10 \pm 0.19$	$29.1 \pm 3.25$
Miosis	$1.23 \pm 0.13$	$18.9 \pm 1.32$	$2.23 \pm 0.38$	$22.4 \pm 2.11$
Bronchorrhea	$1.51 \pm 0.17$	$17.0 \pm 1.24$	$3.22 \pm 0.61$	$17.2 \pm 1.67$
Bradycardia	$1.21 \pm 0.19$	$20.3 \pm 2.23$	$2.39 \pm 0.61$	$21.7 \pm 3.17$
Thoracic rigidity	$1.50 \pm 0.24$	$14.4 \pm 1.46$	$1.19 \pm 0.47$	$26.9 \pm 6.86$
Respiratory paralysis	$1.54 \pm 0.16$	$16.7 \pm 1.19$	$4.09 \pm 0.95$	$22.7 \pm 4.04$
Myofibrillation	$1.15 \pm 0.11$	$21.9 \pm 4.15$	$2.09 \pm 0.37$	$20.7 \pm 1.44$
Retardation of conductivity of contractive myocardium	$0.73 \pm 0.09$	$29.2 \pm 1.83$	$1.67 \pm 0.30$	$29.7 \pm 1.72$
Death	$1.61 \pm 0.16$	$19.0 \pm 1.37$	$4.60 \pm 1.03$	$25.9 \pm 2.29$

Cholinesterase activity was also ambiguous. It was suppressed more by carbofos and BI-58.

direction, determine the initial concentration of poison in the blood from clinical-morphological poisoning symptoms.

We developed normative diagrams that can be employed to determine a typical picture of the body's response from initial poison content in the blood and, in the other

In assessing information value, we analyzed the more basic clinical, laboratory, and functional symptoms of poisonings.

Table 2 presents the comparative information value of symptoms of carbofos, chlorofos, and BI-58 poisonings.

## Comparative Information Value of Clinical, Laboratory, and Functional Symptoms in POP Poisonings

Symptom	Carbofos		Chlorofos		BI-58	
	Rank	Weight	Rank	Weight	Rank	Weight
General data						
sex	62	0.024	64	0.022	62	0.023
age	40	0.137	40	0.128	42	0.136
time elapsed since poison ingestion	1	43.157	1	37.157	1	44.057
Skin						
paleness	28	0.264	29	0.260	28	0.264



Comparative Information Value of Clinical, Laboratory, and Functional Symptoms in POP Poisonings (Continued)

Symptom	Carbofos		Chlorofos		BI-58	
	Rank	Weight	Rank	Weight	Rank	Weight
dampness	59	0.049	60	0.042	58	0.047
Central nervous system						
consciousness	35	0.225	34	0.230	35	0.225
pupil size	11	0.550	12	0.540	10	0.565
corneal reflexes	42	0.124	41	0.128	40	0.132
muscle tone	43	0.122	44	0.120	43	0.132
myofibrillation	30	0.247	32	0.242	31	0.256
tonic spasm	61	0.029	62	0.027	60	0.030
Respiratory organs						
rate	2	4.583	3	3.978	4	4.612
rhythm	49	0.082	50	0.080	48	0.086
type (thoracic diaphragm)	52	0.067	56	0.052	53	0.069
bronchorrhea	23	0.309	26	0.296	23	0.312
bronchospasm	66	0.007	68	0.009	66	0.007
respiratory paralysis	51	0.073	53	0.070	50	0.078
pneumonia	66	0.011	71	0.001	67	0.011
Cardiovascular system						
pulse rate	41	0.131	43	0.127	42	0.135
systolic BP	10	0.554	10	0.554	11	0.550
diastolic BP	7	0.715	8	0.708	7	0.719
cardiac rhythm	68	0.077	70	0.072	68	0.077
Digestive organs						
vomiting	39	0.164	42	0.162	44	0.180
defecation	69	0.003	69	0.003	69	0.003
Electrocardiography						
RR	32	0.231	32	0.230	32	0.231
PQ	50	0.079	51	0.079	50	0.079
QT	55	0.060	55	0.060	55	0.060
QRS	26	0.292	27	0.292	26	0.292
Hemogram						
erythrocytes	6	0.847	7	0.842	6	0.845
leukocytes	4	0.880	4	0.890	5	0.876
hemoglobin	33	0.229	35	0.232	33	0.312
band neutrophils	25	0.293	25	0.286	25	0.290
segmented neutrophils	21	0.364	20	0.384	21	0.365
lymphocytes	64	0.022	61	0.020	63	0.025
monocytes	28	0.421	28	0.418	29	0.415
ESR	19	0.256	19	0.256	19	0.256
cholesterase activity in the blood	24	0.029	23	0.031	24	0.027

As can be seen from Table 2, in POP poisonings, the highest rank in information value belongs to "time elapsed since ingestion of the poison." Of importance are symptoms characterizing respiratory disorders—that's

the main component in the irreversibility in that pathology. A comparative analysis showed that specific symptoms of a given type differ substantially depending on the POP. For example, the type of chemical poison

determines the frequency, rhythm, and type of respiration; paralysis of respiration; and bronchorrhea, bronchospasm, and hemogram.

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### Optimizing Combined Use of Rifampicin and Microbial Immunomodulators in Experimental Q-Fever

917C0453A Moscow ANTIBIOTIKI I  
KHIMIOTERAPIYA in Russian Vol 36 No 1, Jan 91  
(manuscript received 14 Nov 89) pp 20-22

[Article by A. V. Nikitin, N. D. Klimchuk, I. P. Fomina, L. P. Ivanitskaya, and V. N. Rozdobudko, All-Union Scientific Research Institute of Antibiotics, Moscow; Epidemiology and Hygiene Scientific Research Institute, Ukrainian SSR Ministry of Health, Lvov]

UDC 616.98:579.881.11]-092.9-085.332-059:615.275.4]-036.8

[Abstract] The effectiveness of the combined use of rifampicin and a microbial immunomodulator (peptidoglycan) in the management of Q-fever was investigated in albino mice (12-15 g) based on multifactorial analysis. This analysis was employed to construct polynomial statistical models and nomograms for accurate quantitative assessment of the optimal dose-time regimens for administering the preparations. Comparative study of the graphs of the immunizin (complement-binding antibodies) titer and spleen mass functions with drug dose showed their close spatial relationship. The results demonstrated that using high therapeutic doses of antibiotics and the immunomodulator did not decrease the antibody titer. In view of this, using the immunomodulator to adjust the immune response is well-founded. In addition, analysis of the immune response nomograms suggests that the immunomodulator dose should not exceed 500 µg per mouse. These findings indicate that the combined use of the preparations makes it possible to use rifampicin in a 30-fold smaller dose when the immunomodulator is administered three days prior to infection. Figures 1; tables 2; references 2: Russian.

### Chemotherapeutic Effectiveness of Doxycycline in Treating Experimental Q-Fever

917C0453B Moscow ANTIBIOTIKI I  
KHIMIOTERAPIYA in Russian Vol 36 No 1, Jan 91  
(manuscript received 14 Nov 89) pp 22-26

[Article by A. V. Nikitin, N. D. Klimchuk, I. P. Fomina, and V. N. Rozdobudko, All-Union Scientific Research Institute of Antibiotics, Moscow; Epidemiology and Hygiene Scientific Research Institute, Ukrainian SSR Ministry of Health, Lvov]

UDC 616.98:579.881.11]-085.33-036.8

[Abstract] The chemotherapeutic effectiveness of doxycycline in treating Q-fever infection was assessed for both oral and parenteral means of administration. The tasks involved evaluating doxycycline's effect on the immunizin (complement-binding antibody) titer and optimizing therapy parameters based on multifactorial

analysis. The guinea pigs and albino mice were given intraperitoneal or oral doses of 0.5-2 mg doxycycline per animal daily for seven days. The results demonstrated that doxycycline is extremely effective in therapeutic and preventive aspects. The best results for illness prevention for guinea pigs were obtained when 1 mg of the preparation was administered to the animals daily. In a therapeutic respect, the best results were produced when doxycycline was first administered 48 hours after the infection in a daily dose of 0.7 mg per mouse for seven days or 0.9 mg per mouse, four times at 48 hour intervals. Figures 2; tables 4; references 3: 2 Russian, 1 Western.

### Data on Health Norms for Allapinine in Air in Work Area

917C0459A Moscow GIGIYENA TRUDA I  
PROFESSIONALNYYE ZABOLEVANIYA in Russian  
No 1, Jan 91 (manuscript received 6 Dec 89) pp 30-31

[Article by E. U. Suleymanova, F. N. Dzhakhangirov, R. A. Agayev, O. N. Petryakova, and L. A. Globenko, Plant Substance Chemistry Institute, Uzbek SSR Academy of Sciences, Tashkent]

UDC 613.632:613.155.3:615.22]-07

[Abstract] Allapinine is a novel antiarrhythmia agent. It is a white, odorless crystal powder with a bitter taste. Its active agent is a hydrobromide of the alkaloid lappaconitine, which is obtained from the *Aconitum leucostomum* plant. This paper presents the results of an investigation of the parameters of allapinine toxicometry in oral and inhaled administration to rabbits, guinea pigs, and albino mice and rats. The results demonstrated that allapinine is not addictive, and no changes were observed in bone marrow cell chromosomes, thus indicating that it is not mutagenic. While a single inhaled administration (300-400 mg/m<sup>3</sup>) was not lethal to albino rats, and doses inhaled during the second and third trimesters of pregnancy resulted in lower birth weights, results of chronic inhaling experiments indicated that allapinine is highly toxic. In addition, data on the intragastric administration of allapinine also suggest that it is a very dangerous substance. It has a class II hazard rating. References 5: Russian.

### Data on Maximum Acceptable Concentration of Bis-(4-Oxyphenyl) Sulfide in Air of Work Area

917C0459B Moscow GIGIYENA TRUDA I  
PROFESSIONALNYYE ZABOLEVANIYA in Russian  
No 1, Jan 91 (manuscript received 17 Jan 90) pp 31-32

[Article by L. A. Antonovich and V. S. Gordyushin, Medical Institute, Riga]

UDC 613.633:613.155.3]-07

[Abstract] The effect of bis-(4-oxyphenyl) sulfide on the body was investigated on albino mice, rats, guinea pigs,

and rabbits using conventional methods of toxicology research in order to establish health standards for airborne concentrations of the substance in work areas. Methods of biochemical and physiological analysis indicate that bis-(4-oxyphenyl) sulfide upsets oxidation-reduction processes, which suggests a shift in catalase activity. It also decreases the amount of hemoglobin and the number of erythrocytes in the blood. However, it exhibits no effect upon direct contact with the skin. Furthermore, acute poisonings with bis-(4-oxyphenyl) sulfide are not anticipated since it is poorly soluble in water and is only available in powder form. Prolonged chronic exposure results in itching, hyperemia of the skin and membranes, diminished appetite, and enlargement of the liver. These results indicate that bis-(4-oxyphenyl) sulfide is moderately toxic and should therefore be classified as a class III hazard. Treatment for bis-(4-oxyphenyl) sulfide poisoning includes administration of methionine, LIV-52, and vitamins, in addition to limiting salt intake. Wearing of protective masks or respirators and protective creams is advised. References 3: Russian.

**Combined Effects of Ethanol and Chloroorganic Pesticides on Serum Enzymes and Electrolytes**

917C0588B Moscow GIGIYENA I SANITARIYA  
in Russian No 2, Feb 91 (manuscript received  
15 Jan 90) pp 58-59

[Article by L. G. Glukhova, Vinnitsa Medical Institute]

UDC 615.917:547.262].015.2:[615.917:632.9].015.4:  
[615.153.1+616.152.32]/33

[Abstract] Increasing use of pesticides in the agricultural sector and the problem of alcoholism led to an assessment of the combined effects of alcohol and organochlorines on serum enzymes and electrolytes in 160-180 g outbred albino rats. The experiments included per os administration of ethanol (0.9 mg/100 g of 40 percent solution) followed in 24 h by 100 mg/kg of  $\gamma$ -hexachlorocyclohexane (HCCH) or 260 mg/kg of despirol [sic]. The doses of the latter two agents were equivalent to 0.5 LD<sub>50</sub>. The clinical chemistries indicated that alone and in combination these agents alter cell membrane permeability, thereby altering activities of aspartate and alanine aminotransferases, bilirubin concentrations, and serum electrolytes. Successive administration of the xenobiotics elicited sharply different effects from their isolated administration. In the ethanol + HCCH sequence the effects of the latter predominate and ethanol-induced elevation of total bilirubin was corrected to baseline levels. In the case of ethanol + disperol combination ethanol-induced effects on enzymes were attenuated while electrolyte changes reflected disperol dominance. Accordingly, full assessment of the health effects of chloroorganic pesticides must consider the potential impact of other toxicants. References 9: Russian.

**Study in a Multiple-Factor Experiment of the Combined Effect of Doxycycline and a Low Molecular Weight Immunomodulator of Microbial Origin on an Experimental Anthrax Infection**

917C0613 Moscow ANTIBIOTIKI I  
KHIMIOTERAPIYA in Russian Vol 36 No 3, Mar 91  
(manuscript received 14 Nov 89) pp 42-44

[Article by A. V. Nikitin, N. P. Buravtseva, I. P. Fomina, L. P. Ivanitskaya, O. I. Kogotkova, and M. K. Kudinova; All-Union Scientific Research Institute of Antibiotics, Moscow; Scientific Research Antiplague Institute of the Caucasus and Transcaucasus, Stavropol]

UDC 616.98:579.852.11/-092.9-085.332:577.182.54]-  
059:615.275.4]-036.8

[Abstract] The goal of this work was to study the combined activity of doxycycline and a low molecular weight immunomodulator of microbial origin on anthrax infection in mice in a multiple-factor experiment. The experimental factors included  $X_1$ —the dose of doxycycline (in mg per mouse) antibiotic introduced orally every 24 hours after infection for a period of three days;  $X_2$ —the dose of low molecular weight immunomodulator (in mg/kg) preparation introduced in two ways—with the goals of prevention and treatment at various times before or after infection;  $X_3$ —the time for injecting the immunomodulator relative to the moment of infection. The survival rate (in percent of the control level) and average life span (ALS) in days were selected as resultant variables. Experimental results were processed on an SM-4 computer, and second order equations (polynomial statistical models) and contour curves (lines for equal levels) describing the survival rate and ALS were generated. A pronounced synergistic effect of subtherapeutic doses of doxycycline and low molecular weight immunomodulator was established with respect to the survival rate of animals in the model. Analysis of the lines for equal levels allowed the authors to optimize doses and times for applying the immunomodulator, which guaranteed maximum survival rates with the combined therapy. The authors thanked V. M. Fishman for consultation and V. L. Astashkina for constructing the contour curves. Figures 4; references 2: Russian.

**Biological Sensors, Their Use in Medicine and Biotechnology**

917C0614A Moscow ANTIBIOTIKI I  
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[Text] Development of biomedical sciences, biotechnology and microelectronics has made it possible to

create new, more sensitive and sophisticated measuring devices that have come to be called "biological sensors"—BS's (biosensors). The high resolution and specificity of BS's, and the quickness and simplicity of research carried out with them make them essential in monitoring biotechnological processes and in laboratory diagnosis of infectious and somatic diseases in man. BS's are sensitive devices consisting of biological elements possessing sensory properties [10,22,34]. As a rule, the main parts of a BS are: a receptor—an element recognizing a molecule; a transducer—an element that transforms a physicochemical reaction into an electric signal; an element that records the electric signal.

The receptor is one of the main parts of a BS. Enzymes, antibodies, organelles, microorganisms, and cells and tissues of animals, as well as of plants, which are immobilized as a rule on membranes, are used as receptors. Owing to the selectivity and strict specificity of enzyme-substrate and antibody-antigen reactions, a receptor is able to distinguish the substance of interest from other substances. As a result of such reactions, changes arise in the receptor which are detected by the transducer and converted into an electric signal. High-sensitivity electrodes, semiconductor elements, photodiodes, thermistors, field transistors and so on can serve as transducers. The electric signal is amplified and recorded by means of amperometric and potentiometric devices [27,38].

Sensors are subdivided into enzymatic, immune, organoid, microbial, cellular and tissue depending on the biological element used in the receptor.

### Enzymatic Biosensors

Enzymatic BS's are a combination of an electrode and a membrane bearing immobilized enzymes. Clark's glucose sensor was the first BS to be developed [6]. It uses glucose oxidase, which reacts with glucose to absorb  $O_2$  stoichiometrically, or to form  $H_2O_2$ . The quantity of absorbed  $O_2$  may be measured by an oxygen electrode, while the amount transforming into  $H_2O_2$  can be determined with a platinum electrode.

Glucose BS's have enjoyed wide use as a means of determining the quantity of glucose in the blood of sugar diabetes patients, which makes it possible to administer dosed amounts of insulin to them. The range of measurement of blood glucose by means of such a sensor is from  $5 \times 10^2$  to  $(1-5) \times 10^3$  mg/liter, while the time of one analysis is 10-15 sec [25,54].

Glucose BS's have acquired special significance in the development of an artificial pancreas. Small glucose BS's that can be connected to an arterial or venous shunt, and which can directly measure the blood sugar concentration within the organism, have been created [20].

One of the problems of using glucose BS's is their life, which depends on the quality of the enzyme and the means of its immobilization. Immobilized enzymes survive well on membranes for one year at a temperature of

not more than  $5^\circ C$ ; they remain active for two or more months of continuous use at a temperature of  $37^\circ C$ .

Operating dependability, simplicity, convenience and swiftness of determining glucose by means of BS's have made it possible to replace the methods previously used for this purpose by them. Marketing companies in the USA and Japan are producing glucose BS's for medical purposes: YSI-23A, YSI-27, Gluco-20, CA-1110, GL-101 and others [20]. Glucose BS's have been developed to monitor the glucose concentration in biotechnological processes [18,47].

### The Carbamide Biosensor

Carbamide biosensors make use of enzymes which react with a substrate to form  $NH_3$  or  $CO_2$ . A carbamide BS consisting of a membrane bearing immobilized urease as the receptor and a  $CO_2$  or  $NH_3$  electrode as the transducer is the most highly developed. Immobilized urease maintains its activity on a membrane for up to one month, and it can be used to determine urea at a concentration of  $10^3$  mg/liter within 2-60 sec. Carbamide BS's have also been created with immobilized enzymes: glutaminase for determination of L-glutamine, aspartase for determination of L-asparagine, and so on [20].

### Other Enzymatic Biosensor

Interaction of many enzymes with a substrate is known to produce  $O_2$ , which can be measured by means of an oxygen electrode. BS's with immobilized enzymes were created on this basis: uricase to determine urea, invertase (mutarotase) to determine sucrose, xanthine oxidase to determine hypoxanthine, catalase to determine hydrogen peroxide, cholesterol oxidase to determine cholesterol, nucleoside diphosphorylase to determine inosine, and others [16,28,32,42].

Electrodes that register  $H^+$  formed by interaction of some enzymes with substrates are used. Thus, penicillin can be determined by immobilized penicillinase, neutral lipids can be determined by immobilized lipases, and creatinine can be determined by glutaminase within 2 sec at a concentration of  $10^3$  mg/liter. Other enzymatic BS's have been developed as well—salicylate, transaminase, lignin, oxalate, tyrosine, L-lactate, alcohol, phenol, mercury, phosphoric acid and so on [17,44,48,55]. BS's have appeared with immobilized coenzymes; polyfunctional enzymatic BS's that can simultaneously measure several chemicals have also appeared [15,23]. Even this incomplete list of substrates determined by means of enzymatic BS's reveals the various spheres in which they can be used (medicine, microbiology, biotechnology, food industry etc.). Synthesis of artificial enzymes and development of dependable means of their immobilization will make it possible to create new enzymatic BS's for qualitative and quantitative determination of various substances that is presently impossible or difficult [50].



### Immune Biosensors

One of the basic principles of immunology is at the basis of immune BS's—the specificity of interaction between an antigen and an antibody to form a complex. Traditional immunological methods make it possible to reveal small quantities of an antigen or an antibody; however, as a rule this requires running complex reactions that take a significant amount of time. Immune BS's make it possible to detect an antigen-antibody reaction in a few dozen seconds.

Immunological reactions may be divided into two groups: reactions in which a label is not used (agglutination, precipitation etc.), and reactions using labeling agents (immunoenzymatic analysis, immunofluorescence, etc.) [4]. Diverse immune BS's employing the immunological reactions indicated above have been proposed, without a labeling substance and with a labeling agent. In immune BS's without a labeling agent, the antibody/antigen is immobilized on a membrane or an electrode surface. Subsequent interaction with the antigen/antibody leads to formation of an antibody-antigen complex, and the physicochemical changes occurring at this time are recorded in the form of an electric signal. The first immune BS was created to detect syphilis antibodies [5]. Because of the nonspecificity of the cardiolipid sensor, the sensor was characterized by considerable error. Research showed that BS's of this type possess many artefacts, exclusion of which requires separation of the antigen-antibody complex from free substances. However, this procedure is complex, and therefore BS's are being developed in which there is no need for such separation.

In immune BS's of the second type, enzymes are used as the labeling agent—peroxidase, catalase, glucose oxidase,  $\beta$ -galactosidase. Usually the antibody is labeled by the enzyme, but the antigen may be labeled as well.  $O_2$  forms or ions are exchanged as a result of the reaction. The choice of element to be used in an immune BS depends on the transducer within its composition. The transducer can be an oxygen electrode, an ionic electrode or a luminescent system [8,19,20]. The enzyme peroxidase, which is used to label the antibody, is employed in enzymatic immune BS's with a luminescent detection system. A bioluminescent system can also be used as an indicator [51]. The labeled antibody is applied to a light guide connected to a photodetector. The intensity of the sample's glow and its change as a result of the occurring reaction are easily recorded by the photodetector.

Enzymatic immune BS's with several labeled antibodies, which makes them polyfunctional, are being developed. Sensors utilizing electrochemical luminescence of pyrene are also being developed [6]. Antibodies (and antigens) modified by pyrene manifest electrochemical luminescence, as does pyrene. However, when the substance to be analyzed is added and an antibody-antigen complex forms, luminescence is quenched. This phenomenon was used to analyze albumins in human blood serum [6].

Enzymatic immune BS's have been developed to determine albumin, immunoglobulins,  $\alpha$ -fetal protein, chorionic gonadotropic hormone and other substances.

High hopes are being laid on multiclinal antibodies, by means of which the characteristics of immune BS's are to be raised.

It should be noted that immune BS's have not yet enjoyed extensive practical use, but they have a great future in revealing antigens and antibodies. This will require solution of numerous fundamental and applied problems.

### Microbial Biosensors

In addition to enzymatic and immune BS's, another promising type of biosensor is being developed—microbial BS's. The diversity of bacterial exchange processes provides a possibility for using a broad class of specific test organisms as BS's.

A membrane bearing immobilized microorganisms and connected to an electrode is the principal element of a microbial BS. Microbial BS's can be used both on the basis of one microorganismic enzyme (one or several conjugate reactions), and on the basis of a general physiological function of a given microorganism (respiration, metabolic products and so on). Microbial BS's can also be classified in relation to type of electrode, method of recording the response (potentiometric or amperometric), the class of substances to be determined and the areas of application (monitoring enzymatic processes, clinical analysis, ecological research).

Microbial glucose BS's have enjoyed the widest use. A bacterial strain of genus *Pseudomonas* readily absorbs glucose, without consuming other sugars and amino acids in this case. By placing a membrane bearing this immobilized microorganism on an  $O_2$ -electrode, we can create a glucose sensor. An amperometric microbial BS sensitive to glucose containing *P. fluorescens* bacteria immobilized in agar produces a linear response to the glucose concentration in an interval of  $2.5 \times 10^{-5}$  -  $1.25 \times 10^{-4}$  M. The measurement results correlate with the enzymatic method of determining glucose; the sensor is convenient for studying culture media and biological fluids [56]. A microbial BS based on an  $O_2$ -electrode and membranes bearing immobilized *Brevibacterium lactofermentum* was created for sugar consumed by the microorganism [23]. Ascorbic acid, a derivative of glucose, has enormous biological significance. An  $O_2$ -electrode bearing a biocatalyst on its surface—intact *Enterobacter agglomerans* cells on a tyrocellulose filter—was tested as a means of measuring ascorbic acid [57].

Microbial BS's can be used to measure the concentration of important compounds such as amino acids. A sensor consisting of a  $CO_2$ -electrode and membranes bearing immobilized *E. coli* was used to determine glutaminic acid. Bacterial glutamate decarboxylase reduced carbon dioxide gas, which was measured on the basis of electrode potential. The sensor's selectivity is the product of

the absence of the electrode's sensitivity to glucose, acetate ions and inorganic ions [21]. A microbial BS based on a  $\text{CO}_2$ -electrode and a suspension of microorganisms was tested as a means of measuring amino acids such as cystine, serine, glutamine and aspartic acid [23]. L-tryptophan was determined by a  $\text{pO}_2$ -membrane sensor bearing immobilized *P. fluorescens* cells, strain ATCC 13525. A linear response was observed in an interval of substrate values from  $4 \times 10^{-7}$  to  $7 \times 10^{-5}$  M [58].

Microbial BS's are widely used to measure ethanol. One such alcohol sensor is based on a porous acetylcellulose film bearing immobilized *Trichosporon brassicae* cells, covered by a gas-permeable membrane and applied to a series of  $\text{O}_2$ -electrodes. The membrane is secured to a system with a flow-through solution (pH 7.0). The sensor selectively reacts to ethanol—it does not react to methanol and organic acids. A linear dependence exists between the ethanol concentration (below 22.5 mg/liter) and decreasing current strength. If measurements are taken in yeast broth, the output current remains constant for three weeks. This same sensor can be used to measure acetic acid; at a solution pH below the pK of acetic acid (4.75), current decreases in proportion to the acetate concentration. The sensor reacts to propionic and butyric acids [23]. Ethanol can also be measured by means of an electrode bearing *Acetobacter aceti* bacteria in calcium alginate gel using a gas-permeable membrane, a field transistor and a silver comparison electrode [20]. Bacteria oxidize alcohol to acetic acid, and the pH shift is converted into an electric signal. The response time of such a microbial BS is several minutes. It is nonsensitive to methanol, sugars and organic acids. A microbial BS containing *Methylobacterium methylovora* immobilized on a glass mesh electrode or in calcium alginate on a carbon electrode with thionine as the mediator also produces a response to ethanol [16].

The quantity of ammonia must be measured in various biotechnological processes. Microorganisms that oxidize ammonia to nitric acid are called nitrifying bacteria. An  $\text{NH}_3$  sensor consists of an oxygen electrode, *Nitrosomonas* sp. cells that oxidize ammonia to nitrite ions, and *Nitrobacter* sp. cells that oxidize nitrites to nitrates [21]. The minimum ammonia concentration recorded by the sensor is 0.1 mg/liter. A microbial BS based on immobilized *Bacillus subtilis* cells was developed for determination of ammonium ions [43]. The calibration graph is linear in the 0-0.5 mM  $\text{NH}_4^+$  interval, and the response time is 5 sec. Sensitivity persists for 12 days. Chlorides, phosphates and sulfates do not affect the signal's magnitude.

Urea is a valuable nitrogenous fertilizer, and a raw material in chemical industry and in drug production. It hydrolyzes to form ammonia and carbonic acid. Development of a uric microbial BS with a carbonic acid electrode and *Pichia membranaefaciens* yeast cells has been proposed [24].

An  $\text{O}_2$ -electrode can be used to determine the concentration of the antibiotic gentamicin, which affects the duration of the first phase of  $\text{O}_2$  absorption by immobilized *E. coli* cells [26].

Sulfides are used in medicine and agriculture. A photomicrobial electrode formed out of a combination of an electrode and immobilized *Cocomatium* sp. was used to measure sulfide concentration. It had a response time of 5-10 min at a sulfide concentration less than 3.5 mM [33].

Microbial BS's are being used successfully for environmental monitoring. One of the criteria of contamination of rivers and industrial liquid wastes by chemicals is the biochemical oxygen demand (BOD). It is measured by  $\text{O}_2$ -electrodes combined with immobilized *Trichosporon* sp. [2], *Pseudomonas* sp. [61] and *Clostridium* sp. [49] cells. These microbial BS's remain stable for 30 days, and the response time is 30-40 min.

Determination of methylsulfate has great significance to analyzing contamination of industrial wastes. Strain M.219 *Hyphomicrobium* bacteria, which decompose methylsulfate down to sulfate and MeOH, make up a sensor together with a glass electrode, sensitive to methylsulfate concentrations of  $10^{-3}$  to 1 M. The range of linear measurements is  $5 \times 10^{-2}$  -  $6.3 \times 10^{-1}$  M, the response time is 5 min, and stability remains constant for one week [46]. The microbial BS is a quick and inexpensive instrument for drinking water analysis. An amperometric sensor containing *Synechococcus* cells, which produces a signal when the photosynthetic electron-transport system is disturbed, is used to detect chlorotolurone, linurone and other herbicides [14]. Sensors responsive to mutagens and carcinogens have now been developed on the basis of microorganisms (*E. coli*, *Salmonella*, *B. subtilis*) [21].

Efforts to create hybrid enzymatic-microbial sensors using a combination of a microbial and an enzymatic membrane in one device are expanding. Hybrid biosensors possessing urease or creatine kinase immobilized on a porous polyvinyl chloride membrane bearing an ammonia microbial BS have been used for amperometric determination of urea and creatinine. The urease sensor records urea within 50-5 mg/ml, and creatinine is recorded at 100-5 mg/ml. Its stability is not less than two weeks, and its selectivity is sufficient for clinical analyses [30]. Creation of an L-tyrosine biosensor based on a microbial  $\text{CO}_2$  sensor with an attached L-tyrosine decarboxylase and maltose sensor—a combination of glycoamylase and *B. subtilis* cells—and creation of sensors employing thermophilic bacteria have been communicated [24].

A microbial BS is being developed to measure the concentrations of nicotine, vitamins, lipids, nitrous acid, nitrogen peroxide, methane, bacteria quantity and so on [23]. Lower cost and high stability during storage and analysis in continuous mode are doubtless advantages of microbial BS's, although they are inferior to enzymes in

selectivity and response time. Microbial BS's offer promise as a means of measuring environmental characteristics and monitoring biotechnological processes.

#### Light Luciferase Biosensors

Bacteria of genus *Photobacterium* are unique sensory systems that emit light as a result of metabolic processes. Immobilized bacteria or the isolated luciferase-reductase enzyme system are used for analytical purposes. Luciferase BS's designed on their basis possess high sensitivity and low inertia [29].

Microbial luciferase BS's containing immobilized *P. fischeri* cells possess sensitivity allowing them to measure dissolved oxygen down to 3.5 nM, and hydrogen peroxide down to 0.4  $\mu$ M [45]. Mycotoxins in food products (0.9-20.0  $\mu$ g/ml) and trace quantities of narcotics and poisons are determined by means of lyophilized *P. fischeri* cells [2]. Some *P. fischeri* strains are sensitive test systems for various surfactants. Dark mutants of luminescent bacteria capable of regaining luminescence upon addition of nanogram quantities of various mutagens, carcinogens, fatty acids and lipases are sensitive sensors [52,53]. Genetically engineered strains of Gram-negative bacteria, the luciferase system of which is more sensitive to biologically active substances, are used to monitor contamination of the environment by toxic substances.

BS's have been created on the basis of bacterial and firefly luciferase systems for analysis of synthetic and natural aldehydes [1], dehydrogenases [3], proteases and their inhibitors [2], creatine kinases [37], hormones [29] and ethanol [37], the sensitivity of which is on the order of femtomoles [transliteration] for different substrates, and approximately 500 cells per milliliter when determining microbial contamination. Bacterial luciferase is used as a label in immune BS's.

#### Fiber-Optic Photon Biosensors (Optrodes)

Development of BS's using biochemiluminescent systems in combination with fiber light guides and quantitative methods of registering small quantities of biologically active substances is a new, promising direction in development of biosensors [31,32].

Reversibility of their indicator system and short response time are unique features of fiber-optic BS's. Specificity is attained through selection of different optically active fluorescent or bioluminescent labels.

The principle of operation of fiber-optic BS's is as follows: Light travels from the source along an optical fiber to the sensor, which is fitted on the end of the fiber. Upon being reflected or scattered by the sample, it returns to the light receiver, which analyzes the returning signal. The spectral composition of reflected light may be changed as it passes through the sample under analysis, which contains an optically active reagent.

An optical "metabolic" sensor—a miniature sensitive glucose sensor—has been proposed. Its detection principle is based on competition between the metabolite to be determined and a fluorescein-labeled ligand for a receptor binding site [40]. The system uses filters that block scattered radiation. The response time in such an optrode is 7-10 min, and measurement accuracy for glucose is 0.13 mg/liter.

A fiber-optic BS with five sensors has been used to study the pH gradient in cardiac muscle [39]. The measurement procedure used by this sensor is relatively simple and inexpensive. Registration and analysis are carried out by means of a photomultiplier tube connected to a processor.

A fiber-optic BS has been proposed for measuring pCO<sub>2</sub>. In it, a Soverinkhauz [transliteration] electrode measures the pH of bicarbonate solution in a container secured to the end of a light guide [41].

Another fiber-optic BS has been developed for determination of O<sub>2</sub> utilizing phosphorescence of a dye [13]. The structure of the O<sub>2</sub> sensor is similar to that measuring pH. A powdered dye applied to organic adsorbents was placed in a porous polypropylene capsule at the end of a light guide. Illumination with blue light excites phosphorescence in the dye, as a result of which a green glow is emitted with intensity that is inversely proportional to oxygen pressure.

Phosphorescing reagents have also been used to determine metallic ions. The concentration of halogen ions and pH are determined in the physiological range on the basis of fluorescent quenching by means of indicator systems based on polymer adsorbents [13]. Optical gas-discharge sensors based on fluorescent quenching of pyrenbutyric acid have been proposed for determining oxygen [36]. An ammonium sensor containing a sensor precipitated onto an optical fiber has also been reported [35]. Fiber-optic BS's are ideal systems for determining gases in biological objects, because their response time is short and their sensitivity is high (0.017 pH sec<sup>-1</sup>, 0.6 percent pO<sub>2</sub> sec<sup>-1</sup>).

Fiber-optic BS's can register not only fluorescence and chemiluminescence, but also change in color of the sample under analysis. An optical enzymatic sensor containing alkaline phosphatase was used to determine p-nitrophenylphosphatase. Change in substrate color is registered by a photodiode. An enzymatic electrode in which a photodetector of peroxidase (or a more complex reaction chain) is secured to a silicon surface has been proposed for quantitative determination of hydrogen peroxide, and for analysis of the activity of oxidases and products—glucose, cholesterol, uric acid, hypoxanthine etc. [6].

Polyenzymatic complexes connected to a permeable membrane at the end of an optical light fiber will become the principal sensory systems of specific sensors in the future. Fiber-optic BS's are a new means of obtaining biological and chemical information. They are essential

wherever such information is hard to obtain by other means, especially in medicine, when the sensory components must be sterilizable, biocompatible and calibrated precisely.

### Semiconductor Biosensors

Semiconductor field transistors are among the most promising BS transducers. Semiconductor sensors are divided into three basic classes in correspondence with the given function—gas, ionic and biochemical. The last class may be grouped with semiconductor BS's, inasmuch as biological elements such as enzymes, antibodies, bacteria, tissue cells and various organoids are used in them as sensors.

Beginning with the work of Bergveld [9], who was the first to propose using a field transistor to create semiconductor BS's, different variants of such semiconductor structures have been discussed in the literature [32]. The significant amount of attention devoted to such semiconductor BS's is associated with use of integrated technology, which makes it possible to reduce the dimensions of the transducers and form different electric circuit components on the same chip on which the BS is built. Also important is the possibility of creating so-called multibiosensors (polyfunctional semiconductor biosensors) and organizing their mass production. A multibiosensor based on four field transistors, each of which is covered by a corresponding membrane, has been designed [31]. One of them contains urease and is used to determine urea, another determines glucose oxidase (glucose), the third determines valinomycin (potassium), and the fourth determines albumin and serves as a comparison sensor, which undergoes differential activation depending on changes in the three other variables. It should be noted, however, that the output characteristics of many such multibiosensors are nonlinear.

A high degree of integration, and the possibility of creating polyfunctional sensors and using them for continuous monitoring are advantages of semiconductor BS's.

BS's have become an object of research in many countries of the world; however, Japanese scientists are playing the leading role in their design and use [5,6,20,23,24]. The results of BS research are published in biological, medical and physicochemical publications. The wide possibilities of using BS's are attracting the attention of government scientific institutions and private firms. England has established a scientific and technical council on BS's funded with 5 million pounds Sterling annually to subsidize efforts in this direction [60], while outlays in Japan are around 10 billion yen per year [12]. Bioengineering companies are displaying special interest in BS's. The BS market in the USA is now valued at \$8 million, in 1990 it will rise to \$17 million, in 1995 it will increase to \$80 million, and in the year 2000 it will be \$200 million [11]. The BS market is growing rapidly in the FRG: 39,000 marks in 1985, and around 10 million marks in 1990; it will become the

largest in Europe [59]. There are plans in England to sell BS's worth a total of \$8.6 million in 1990 [60].

It is anticipated that BS's will be used extensively not only in medicine and biotechnology but also in analytical instrument-making, agriculture, pharmaceutical industry and microelectronics, as well as in the creation of biocomputers [7].

Thus BS's are a more sophisticated and informative level of development of methods of analyzing complex systems. Today, BS's are taking their "first steps," and we can expect that in the very near future, sensors operating on the basis of new principles will make their appearance. Development and creation of BS's is the most urgent task of today.

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**Effect of N-Acetylaspartic Acid on Memory and Learning Processes in Rats**

917C0621A Moscow *FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian* Vol 54 No 1, Jan-Feb 91 (manuscript received 6 Mar 90) pp 8-11

[Article by G. V. Kovalev (deceased), V. A. Sazhin, and A. V. Yanitskaya; Pharmacology Department (director—Professor G. V. Kovalev, deceased), Volgograd Medical Institute, Volgograd, 400066, pl. [Square] Pavshikh Bortsov, 1]

UDC 612.821.2/.3.014.46:615.31:577.112.384.2

[Abstract] The effect of 10-100 mg/kg intraperitoneal and oral doses of the neurospecific substance N-acetylaspartic acid (AcAA) on memory and learning processes in rats was studied in this work. The AcAA in the form sodium N-acetyl-D,L-aspartate was synthesized by Candidate of Chemical Sciences A. A. Ozerovyy (Volgograd). The substance restored the passive avoidance habit during electric shock and scopolamine amnesias, as well as during natural extinction of the habit. Chronic injection of AcAA improved learning in a water maze, but it did not affect acquisition or retention of the active avoidance habit in the shuttle box. It has been hypothesized that AcAA increases the functional activity of neurons either by intensifying acetylation processes in a similar manner to acetylcarnitine, another acetyl group transmitter, or by affecting lipid biosynthesis since it is known that several lipids restore memory in the case of brain damage. It is also possible that stimulant mediator amino acids participate in the psychotropic effects of AcAA since it is able to stimulate the release of glutamate from brain synaptosomes *in vitro*. The authors concluded that AcAA may be considered a promising agent for correcting disorders in certain types of memory. Figures 2; references 15: 4 Russian, 11 Western.

**Comparative Study of Nootropic Properties of Piracetam and Oxiracetam**

917C0621B Moscow *FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian* Vol 54 No 1, Jan-Feb 91 (manuscript received 11 Sep 89) pp 14-16

[Article by I. N. Krylova, L. V. Antonova, A. A. Kamen'skiy, and V. V. Yasnetsov; Complex Laboratory (director—G. O. Lilp), Biology Department, MGU [Moscow State University], 117234, Leninskiye Gory, MGU; Scientific Research Laboratory of Biologically Active Substances From Hydrobionts (director—O. G. Sakan-delidze), USSR Ministry of Public Health (Minzdrav), Moscow, 129243, ul. [Street] Kosmonavtov, 18, k. [Building] 2]

UDC 615.214.015.4:612.821.1/.3].07

[Abstract] The effects of piracetam ("Olaynfarm" [Olayne Pharmaceuticals], Olayne) and oxiracetam (Scientific Research Institute of Biotechnology, USSR Minzdrav) on the behavioral activity of unrelated male white

rats who were being subjected to electroconvulsive shock-induced amnesia and who were learning eating habits in a T-shaped maze and conditioned passive and active avoidance reactions were studied. The level of the orientation reaction and emotionality of the animals were determined by the open field method. Intraperitoneal injections of 10 mg/kg of oxiracetam and 100 mg/kg of piracetam were required to achieve the same effect. Both nootropics protected against electric shock-induced amnesia and facilitated learning in the animals but did not change their behavior in the open field. Piracetam was more effective in the test for developing a conditioned active avoidance reaction, and oxiracetam—while the rats were learning an eating habit. The data attested to several differences in the activity of piracetam and oxiracetam, indirectly indicating a high specificity of nootropic preparations and possible heterogeneity of nootropic receptors. Figures 3; references 12: 5 Russian, 7 Western.

**Toxic and Immunomodulating Properties of O-Somatic Antigen Polysaccharide From Typhoid Bacteria**

917C0621C Moscow *FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian* Vol 54 No 1, Jan-Feb 91 (manuscript received 18 Aug 89) pp 40-43

[Article by A. P. Duplishcheva, N. G. Sinilova, A. M. Kharitonova, S. I. Bykovskaya, L. V. Grigoryeva, A. Ye. Snegireva, G. V. Shaposhnikova, I. V. Andreyeva, and O. Yu. Rusina; Laboratory of Natural Immunity (director—Candidate of Biological Sciences A. V. Pronin), Laboratory of the Microbiology of Latent Infections (dir.—Professor V. A. Zuyev), Laboratory of Integrated Infections (dir.—Professor V. Ya. Shevlyagin), and Laboratory of Bacterial Genetics (dir.—USSR Academy of Medical Sciences (AMN) Academician Professor A. K. Skavronskaya), Scientific Research Institute of Epidemiology and Microbiology imeni N. F. Gamaleya, USSR AMN, Moscow 123098, ul. [Street] Gamalei, 18]

UDC 615.275.4].099.07

[Abstract] In previous work, the authors had isolated O-somatic antigen polysaccharide from typhoid bacteria and designated it "salmosan". The primary goals of this work were to study the toxic properties of salmosan and its effect on natural nonspecific resistance to infection. It was shown in experiments on laboratory animals (unrelated white mice, rats, rabbits, and macaque rhesus monkeys) that salmosan is not toxic nor does it exhibit carcinogenic, mutagenic, or allergenic properties when parenterally administered in therapeutic doses. Salmosan exhibits immunomodulating activity in that it increases the body's nonspecific resistance to infection, it induces polyclonal activation of B-lymphocytes, and it activates cells in the mononuclear phagocytic system. Salmosan's effect on nonspecific resistance to infections was evaluated by parenterally administering it to mice two to three days before infecting them with *Salmonella*

*typhi*, 4446, *Klebsiella pneumoniae* K-2, and *Listeria monocytogenes* typhoid bacteria. These mice had a higher resistance to the bacteria than the controls. References 14: 11 Russian, 3 Western.

#### Clinical Pharmacokinetics of Kemantane

917C0621D Moscow FARMAKOLOGIYA I  
TOKSIKOLOGIYA in Russian Vol 54 No 1, Jan-Feb 91  
(manuscript received 27 Sep 89) pp 57-59

[Article by S. S. Boyko, V. P. Zherdev, and N. A. Kislyak; Laboratory of Pharmacokinetics (director—Doctor of Medical Sciences V. P. Zherdev), Scientific Research Institute of Pharmacology, USSR Academy of Medical Sciences, Moscow, 125315, Baltiyskaya ul. [Street], 8]

UDC 615.275.4.038

[Abstract] The pharmacokinetics of the new domestically produced immunostimulator kemantane, an adamantane derivative with the chemical name 1-oxyadamantane-4-one, were studied by gas-liquid chromatography in patients with bronchial pathologies. It was established that the unchanged form of kemantane was practically undetected in the patients' blood due to the intensely pronounced effect of its first passage through the liver. Kemantane was rapidly metabolized in the liver to form its primary metabolite, adamantane-1,4-diol, which exhibits an analogous activity. Kemantane's kinetics were evaluated via this metabolite. Significant differences were identified in the metabolism rate, in the metabolite's time of appearance in the circulatory system, and in its elimination rate in men and women. In women, there was a higher maximum concentration of the preparation in the blood, the time for achieving the maximum was shorter, and the half-life was shorter than in men. Kemantane was eliminated in the urine primarily in the adamantane-1,4-diol form, whose excretion comprised 0.6 percent of the administered dose of the preparation. On the basis of conducted investigations, a scheme was recommended for administering kemantane to patients with lowered immunity. Figures 2; references 4: Russian.

#### Preclinical Study of Embryotoxic Properties of Cucumariosid and Its Effect on the Generative Function of Adult Specimens

917C0621E Moscow FARMAKOLOGIYA I  
TOKSIKOLOGIYA in Russian Vol 54 No 1, Jan-Feb 91  
(manuscript received 13 Nov 89) pp 60-61

[Article by L. V. Sharova, A. M. Sedov, and V. A. Stonik; Division of Immunomodulators (director—Candidate of Biological Sciences A. M. Sedov), Scientific Research Laboratory of Biologically Active Substances From Hydrobionts, USSR Ministry of Public Health, Moscow, 129243, ul. [Street] Kosmonavtov, 18, korp. [Building] 2]

UDC 615.275:547.918].03:[616-092:612.017.1]  
.015.4:618.33].076.9

[Abstract] The goals of this work were to conduct a preclinical investigation of the embryotoxic properties (embryo lethality, teratogenicity) of cucumariosid and to study the effect of its long-term application on the postnatal development of progeny and the generative function of adult specimens. Cucumariosid, produced at the Pacific Ocean Institute of Bioorganic Chemistry, Far East Department of the USSR Academy of Sciences, is the total fraction of tetracyclic triterpene glycosides from Far East sea cucumbers *Cucumaria japonica*, and it exhibits pronounced immunomodulating properties. With long-term application in large doses (total received dose 20-55 mg/kg), cucumariosid did not affect the generative function of rats, the general condition of pregnant females, or the postnatal development of progeny, and it did not exhibit teratogenic activity. Use of the preparation during the preimplantation and implantation periods of pregnancy produced a contraceptive effect. Discovery of cucumariosid's contraceptive effect is of particular interest due to the absence of teratogenic activity and neurophysiological defects in the postnatal period. References 7: 4 Russian, 3 Western.

#### Effects of Novel Gossypol Derivatives on Cooperative T and B Cell Response Against Sheep Erythrocytes

917C0630B Tashkent DOKLADY AKADEMII NAUK  
UZSSR in Russian No 10, Oct 90 (manuscript received  
14 Mar 90) pp 57-59

[Article by G. A. Ismailova and K. G. Urazmetov, Tashkent Order of the Red Banner of Labor State Medical Institute; Scientific Research Institute of Dermatology and Veneorology, Uzbek SSR Ministry of Health]

UDC 612.6.02.015.37:615.32

[Abstract] Trials were conducted with a series of gossypol derivatives and gossypol on the interaction of T and B cells in the genesis of an antibody response against sheep erythrocytes (SRBC), a T-dependent antigen. The studies were performed on lethally irradiated (9 Gy) CBA mice transplanted with either thymic or bone marrow cells, or a combination of the cells, immunized with SRBC, and treated intragastically with mabavin [sic], kagotsel [sic], gossypol, batriden [sic] or azathioprine. Assessment of splenic antibody-forming cells demonstrated that mebavin treatment reduced the antibody response by 76 percent, batriden by 63.7 percent, azathioprine by 77.1 percent, kagotsel by 80.0 percent and gossypol by 73.1 percent. These observations indicate that mebavin and kagotsel are equipotent with azathioprine and gossypol in inhibiting T and B cell cooperation. Tables 1; references 3: 1 Russian, 2 Western.

### Fusion of Protoplasts of Inactive Variants of Two Actinomycin C Producers and Biosynthesis of an Antibiotic of a Non-Actinomycin Nature

917C0631A Moscow ANTIBIOTIKI I  
KHIMIOTERAPIYA in Russian Vol 36 No 4, Apr 91  
(manuscript received 28 Apr 89) pp 3-5

[Article by T. I. Orlova, Biology Department, Moscow University imeni M. V. Lomonosov]

UDC 616.332.012.6.07

[Abstract] In this work, the author attempted to produce recombinant strains of streptomycetes that would synthesize antibiotics with qualitative compositions different from those of the parent strains. To solve this problem, the author utilized the PEG-6000 [not further identified] to induce protoplast fusion of *S. Chrysomallus* 305-1 (Pro, Arg) and *Streptomyces* sp. 26-115 H-2 (Gly, Asp), inactive variants of two actinomycin C producers. These variants did not synthesize actinomycin C but did synthesize different antibiotics of an undetermined nature in trace amounts. The fusion process yielded a number of stable recombinants. One of these, designated recPro due to its requirement for proline for growth, synthesized an antibiotic not synthesized by any of its parent strains. This antibiotic suppressed the growth of *Saccharomyces cerevisiae* and Gram-positive bacteria. It was found, however, that recPro's ability to produce the antibiotic was unstable and completely disappeared after the strain had been stored for five to seven months. The antibiotic substances from the other recombinants are currently being studied. Figures 2; references 18: 6 Russian, 12 Western.

### In Vitro Activity of the New Glycopeptide Antibiotic Eremomycin Against Obligate Anaerobic Gram-Positive Bacteria

917C0631B Moscow ANTIBIOTIKI I  
KHIMIOTERAPIYA in Russian Vol 36 No 4, Apr 91  
(manuscript received 14 May 90) pp 17-20

[Article by I. V. Malkova, O. K. Borisova, M. V. Pavlova, Ye. P. Zemlyanitskaya, and T. I. Sergeyeva; All-Union Scientific Research Institute (VNII) for Investigating New Antibiotics, USSR Academy of Medical Sciences; Institute of Surgery imeni A. V. Vishnevskiy, USSR Academy of Medical Sciences, Moscow]

UDC 615.332:577.182.82]015.44:579.86

[Abstract] The glycopeptide antibiotic eremomycin was recently developed at the VNII for Investigating New Antibiotics. The goals of this work were to study its activity against obligate anaerobic Gram-positive cocci and to evaluate its effectiveness *in vitro* compared to other glycopeptide antibiotics such as vancomycin, teicoplanin, and ristomycin. Eremomycin was highly active against Gram-positive cocci and bacteria of the *Clostridium* genus. Eremomycin also had fairly low

MAC (maximum allowable concentration) values and a narrow range of variation in these values, which are definite advantages of the preparation. Eremomycin's antibacterial activity was two times higher than that of vancomycin and eight times higher than that of ristomycin against Gram-positive anaerobic cocci. Pathogenic *Clostridium* strains were two to four times more sensitive to eremomycin than to vancomycin. Eremomycin suppressed the growth of Gram-positive aerobic and obligate anaerobic cocci in similar concentration ranges, indicating that it could play a significant role in the monotherapy of combined aerobic-anaerobic infections. References 9: 6 Russian, 3 Western.

### 3,5-Dimethyl-5-n-Alkoxyphenylhydantoins and Their Neurotropic Properties

917C0642B Moscow  
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL  
in Russian Vol 25 No 3, Mar 91 (manuscript received 20 Apr 90) pp 32-34

[Article by I. A. Dzhagatspanyan, L. V. Azaryan, G. G. Melikyan, I. M. Nazaryan, S. A. Avetisyan, O. L. Mndzhoyan, and K. A. Tatevosyan, Fine Organic Chemistry Institute imeni A. L. Mndzhoyan, Armenian SSR Academy of Sciences, Yerevan]

UDC 615.214.32:547.783].03.07

[Abstract] Methyl iodide was used to methylate 5-methyl-5-n-alkoxyphenylhydantoins to produce eight derivatives. Pharmacological trials were performed to compare 5-n-alkoxyphenyl-3,5-dimethyl hydantoins with known anti-epileptic agents (diphenin, mesantoin, anxiolytic seduxen, nootropil). The objective of this investigation was to identify novel anticonvulsant compounds with atypical action. The substances were administered intraperitoneally to rats 45 minutes before the beginning of the experiment. These compounds were found to be low in toxicity and exhibited anxiolytic, anti-amnesic, and anti-electrical shock activity. The most effective derivative (R = iso-C<sub>3</sub>H<sub>7</sub>) is similar to the methyl analog of hydantoin, mesantoin. These data on the effects of methyl-substituted hydantoins suggest that the further synthesis and investigation of this series of compounds will be promising. Figures 1; tables 3; references 11: 3 Russian, 8 Western.

### Mechanisms of Anticoagulating Activity of New Semisynthetic Heparinoids

917C0643A Moscow GEMATOLOGIYA I  
TRANSFUZIOLOGIYA in Russian Vol 36  
No 4, Apr 91 (manuscript received 15 Feb 90) pp 23-25

[Article by L. A. Azarova, V. A. Syatkovskiy, Professor F. N. Kaputskiy, and V. I. Torgashov; Scientific Research Institute (NII) of Radiation Medicine, BSSR Ministry of Public Health; NII of Physical-Chemical Problems, Belorussian State University (BGU) imeni V. I. Lenin, Minsk]

UDC 615.273.53.012.1+615.273.53.015.4:612.115

[Abstract] In this work, the effect of 64 semisynthetic heparinoids (chemically modified derivatives of the natural polysaccharides mannan, dextran, starch, cellulose, pectin, ethoxy starch, inulin, and chitosan) on the hemocoagulation system was studied. The preparations were synthesized at the NII of Physical-Chemical Problems, BGU, by two new polysaccharide sulfation methods. The primary feature of these methods involved removing the most aggressive chemical agents (nitrogen and sulfur oxides, etc.). This enabled the authors to reduce the toxicity of the obtained substances, which is one of the primary disadvantages in their clinical application. The authors isolated compounds that, based on their total positive properties (accessibility of the matrix, pronounced effect on plasma and thrombocyte components of the hemostasis system, and fibrinolytic activity), could be considered most promising for further development as pharmacological preparations: starch and mannan sulfates realized their anticoagulant potentials without the participation of antithrombin-III, pectin sulfates—as anticoagulants, and inulin sulfate—as a possible antiaggregant. A relationship was established between the biological properties of the compounds and the percent sulfur, molecular weight, and polymer matrix. Figures 1; references 13: 4 Russian, 9 Western.

**Aberrations in Blood and Bone Marrow Indicators According to Data From Complex Cytological Studies on 28 Children From the Bryanskaya Oblast One Year After the Chernobyl Nuclear Power Plant Accident**

917C0643B Moscow GEMATOLOGIYA I  
TRANSFUZIOLOGIYA in Russian Vol 36 No 4, Apr  
91 (manuscript received 6 Aug 90) pp 25-28

[Article by R. V. Lenskaya, A. G. Rymyantsev, V. M. Buyankin, V. A. Ageykin, L. V. Baydun, T. M. Borodina, V. I. Vasilyev, Ye. V. Vladimirskaia, N. V. Zamarayeva, Yu. A. Knyazev, R. P. Nartsisov, S. V. Petrichuk, Ye. V. Samochatova, and D. A. Torubarova; II Moscow Order of Lenin and Order of the Red Banner of Labor Medical

Institute imeni N. I. Pirogov; All-Union Hematological Science Center, USSR Ministry of Public Health (Minzdrav); Moscow Scientific Research Institute of Roentgenology and Radiology, RSFSR Minzdrav; Institute of Pediatrics, USSR Academy of Medical Sciences, Moscow]

UDC 616.15+616.419]-076.5-053.2(470.333)-  
02:614.876[477]

[Abstract] In this work, the authors analyzed bone marrow and peripheral blood samples from 28 children (ages four to 14) from the Bryanskaya Oblast who had been hospitalized in the Moscow Republic Children's Hospital for various health problems. Several studies were conducted, including morphological, cytochemical, and immunological. The activity of incorporated cesium-137 was 0.01-0.2  $\mu\text{Ci}$  in the children at the time of the study (June 1987). The authors concluded that the extreme conditions of radioactive damage by small doses affected blood formation in the bone marrow of children differently, depending on sex and age. Bone marrow lymphoid reactions were observed more often in younger children, while more pronounced metabolic aberrations were observed in the peripheral blood lymphocytes of older children. In all cases, the cytochemical characteristics of blood and bone marrow lymphoid cells deviated from normal. Lymphocyte immunophenotyping and other tests revealed heterogeneity in all the indicators among the children, which may be an example of biological diversification. This theory was supported by a sharp increase in cell heterogeneity (coefficient of variation), partial disruption of the equilibrium of cells with low and high mitochondrial  $\alpha\text{-GFDG}$  enzyme activity during a significant decrease in this enzyme's average activity, and the high diversity of cells with the onset of LDG activity. Paired correlation of 50 blood and bone marrow indicators with the activity of incorporated cesium indicated that cesium activity was directly linked to the hemoglobin level, bone marrow cytosis, intensity of the granular ShIK-reaction (change in the neutral mucopolysaccharide content) of bone marrow lymphocytes, and several phagocytosis indicators. References 6: Russian.



### Effect of Tuftsin on Motor Activity of Rats After Different Methods of Its Introduction Into Organism

917C0582A Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: BIOLOGIYA in Russian Vol 16 No 1, Jan-Mar 91 pp 34-38

[Article by N. Yu. Sarucheva, V. N. Kalikhevich and A. A. Kamenskiy]

UDC 615.276.4.015.4:612.821.1/3

[Abstract] Comparison of the neurotrophic effect of tuftsin after intraperitoneal and intranasal methods of administration involved experiments on 150-250 g male mongrel white rats. Rats received intranasal administration of 20  $\mu$ l of tuftsin per rat or intraperitoneal administration of 200  $\mu$ l per rat. Tuftsin doses studied include 300, 30, 15 or 6  $\mu$ g/g. An "open field" test revealed the exploratory activity of the rats and an actometer measured their motor activity. Tuftsin displayed neurotrophic activity after both methods of administration: exploratory behavior, motor activity and emotional state of the rats changed. Reduction of the dose by a factor of 1 in intraperitoneal administration eliminated the excitatory effect of tuftsin. The effect of tuftsin after intranasal administration was 10-fold greater than that produced after intraperitoneal administration. Some explanations of these differences in effect of intranasal and intraperitoneal administration were discussed briefly. References 12: 5 Russian, 7 Western.

### On the Role of Heat Shock Proteins in Natural Adaptation to Heat

917C0600B Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 316 No 3, Jan 91 (manuscript received 19 Oct 90) pp 749-752

[Article by Kh. A. Ulmasov, V. K. Dashkevich, S. Shammakov, K. K. Karayev, A. Kh. Babayeva, and M. B. Yevgenyev; presented by Academician G. P. Georgiyevy 9 Oct 90; Institute of the Physiology and Experimental Pathology of Arid Zones, TurkmenSSR Academy of Sciences, Ashkhabad; Institute of Zoology, TurkmenSSR Academy of Sciences, Ashkhabad; Institute of Molecular Biology imeni V. A. Engelgardt, USSR Academy of Sciences, Moscow]

UDC 577.122+612.591.1+598.111.6

[Abstract] In this work, the authors presented results from analyzing the mechanism between the level of heat shock proteins (HSP) and temperature conditions for a wide range of lizard species, representing various climate-geographic zones of the USSR. Their goal was to establish a general biological criterion for this mechanism. The analysis included determining the content of HSP70 (a group of stress proteins that prevent the aggregation of denatured and aberrant proteins and act

to preserve polypeptides' competent forms), their relative rates of synthesis, and the level at which they were coded in mRNA at standard conditions (25° C). It was determined that the lizards' adaptation to the nonspecific effect of heat, along with the development of a number of behavioral reactions, was accompanied by the onset of several molecular mechanisms, including an external temperature-dependent dosed activity by the heat shock gene system that was achieved by the establishment of a corresponding intracellular concentration of HSP. Apparently, the high content of these stress proteins in lizards from southern latitudes, compared to the "northern" types, is necessary for guaranteeing the growth of normal cells and the protective functions of HSP70 in accordance with absolute temperatures of the environment and body. The authors concluded that there is a true mechanism linking the temperature of an animal's habitat with the content of HSP70-like proteins, which play an important role in natural adaptation to heat at the level of the organism as a whole. The authors thanked B. A. Margulis, I. Yu. Abramovaya, and S. B. Akopov. Figures 3.

### Difference in Oxidative Metabolism Shifts of the Brain During Active and Passive Types of Behavior

917C0600C Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 316 No 3, Jan 91 (manuscript received 1 Oct 90) pp 754-758

[Article by K. Yu. Sarkisova; presented by Academician P. V. Simonovyy 26 Sep 90; Institute of Higher Nervous Activity and Neurophysiology, USSR Academy of Sciences, Moscow]

UDC 612.821.6+612.826

[Abstract] Neurophysiological mechanisms based on the pathogenic properties of passive-defensive behavior are not known, nor are the mechanisms of the mixed effect of active behavior (positive, negative) on the development of various pathological processes. In connection with this, the authors studied indicators of the brain's oxidative metabolism—rate of local blood flow (RLB) and the free oxygen potential ( $pO_2$ )—in the lateral hypothalamus, thalamus, and dorsal hippocampus during active (searching and active fight-or-flight reactions) and passive (passive-defensive, backing down reactions) types of behavior. The experiments were conducted on 22 male white rats with time synchronized platinum electrodes (200  $\mu$ m diameter) in the brain regions listed above. The RLB was determined by the quantitative hydrogen clearance method, and  $pO_2$  was recorded polarographically during active and passive types of behavior that were induced naturally or artificially (with electric stimulation). Data obtained in this work confirmed that active behavior is accompanied by an increased RLB where oxygen transport "hypercompensates" for higher demand by the nerve tissue (as compared to a calm, awakened state). Passive behavior is



accompanied by either an increased RLB where oxygen transport does not compensate for increased demand by the nerve tissue (functional hypoxia) or a decreased RLB (circulatory hypoxia). Changes in the  $pO_2$  level had a more differentiated character (it increased during active and decreased during passive behavior) than changes in RLB (it increased during both types of behavior). This led the authors to conclude that changes in RLB are more closely associated with the intensity of emotional stress, and changes in the  $pO_2$  level—with subjective evaluation by the brain of the probability (possibility) of satisfying a need, which determines the behavioral strategy. Figures 2; references 9: 5 Russian, 4 Western.

**Effect of Acute Psychogenic Stress on Status of Some Functions of Visual Analyzer**

917C0604B Moscow VESTNIK OFTALMOLOGII in Russian Vol 107 No 1, Jan-Feb 91 (manuscript received 28 Mar 90) pp 17-19

[Article by E. S. Avetisov, R. A. Gundorova, A. A. Shakaryan, and A. A. Oganessian, Moscow Scientific Research Institute of Eye Diseases imeni Gel'mgolets; Yerevan Medical Institute imeni Gerats]

UDC 617.75-092:[613.863:550.348.436]-07(479.25)

[Abstract] The effect of acute psychogenic stress on the status of the accommodative and binocular functions of the visual analyzer was investigated on 742 people aged five to 58 years. These individuals were inhabitants of the areas hardest hit by the earthquake in Armenia and had been examined by an ophthalmologist less than one year before the earthquake and did not have any history of eye problems. Ninety-five percent of those examined noted diminished visual acuity for distance in both eyes. Strabismus was detected in 28 children and appeared in most cases within 1.5-2.5 months after the earthquake. Twenty-seven percent of those examined were found to have pseudomyopia. These data suggest that the earthquake was a source of profound psychogenic stress, which takes its toll on the visual analyzer in the form of impairments to the binocular and accommodative functions, especially in children. Accordingly, the prompt identification and treatment of victims in areas of natural disasters is recommended. Tables 1; references 3: Russian.

**Impact of Immunomodulators on High Altitude Adaptation of Myocardium, Lungs and Liver**

917C0619A Leningrad ARKHIV ANATOMII, GISTOLOGII I EMBRIOLOGII in Russian Vol 99 No 12, Dec 90 (manuscript received 12 Apr 90) pp 10-13

[Article by V. Sh. Belkin, Laboratory of High Altitude Biomedical Research, Department of Protection and Rational Utilization of Natural Resources, Tajik SSR Academy of Sciences, Dushanbe]

UDC 611.127+611.24+611.36]087.1:612.017.1/2:613.12(23.03):599.323.4

[Abstract] Outbred male rats, 18-22 g, were used in an assessment of the involvement of immune factors in myocardial, pulmonary and hepatic adaptation to high altitude (4,000 m above sea level). The experimental approach utilized groups of animals pretreated with cyclophosphamide (200  $\mu$ g/kg; i.p.) to depress humoral immunity, T-activin (10  $\mu$ g/kg; 5 times) to stimulate cellular immunity or cyclophosphamide + T-activin combination before high altitude exposure. Administration of these agents at sea level was without effect on the target organs. However, at 4,000 m either agent and their combination potentiated the effect of high altitude, resulting in extensive dystrophic changes including diminished pulmonary air volume. In addition, erythrocyte production was enhanced in animals pretreated with cyclophosphamide and inhibited to below control levels in the T-activin group. After four weeks at high altitude histologic evidence of recovery was evident in control animals and the T-activin group. Cyclophosphamide-treated animals continued to display progression of histologic deterioration, demonstrating the importance of B cell-based immunity in normal adaptation to hypoxia. Intermediate levels of adaptation were evident in animals treated with the cyclophosphamide + T-activin combination. Figures 1; tables 1; references 14: 12 Russian, 2 Western.

**Immunomodulator Effects on Rat Thymus in High Altitude Adaptation**

917C0619B Leningrad ARKHIV ANATOMII, GISTOLOGII I EMBRIOLOGII in Russian Vol 99 No 12, Dec 90 (manuscript received 29 Jun 90) pp 14-17

[Article by M. Yu. Kuinova, Laboratory of High Altitude Biomedical Research, Department of Protection and Rational Utilization of Natural Resources, Tajik SSR Academy of Sciences, Dushanbe]

UDC 611.438.018:612.017.1/2:613.12(23.03):599.323.4

[Abstract] Thymic histology was assessed in outbred male mice, 18-20 g, in response to high altitude (4,000 m above sea level) in three groups of animals: controls, animals pretreated with hydrocortisone (HC; 2.5  $\mu$ g/100 g), and cyclophosphamide-treated mice (200  $\mu$ g/kg) to modify baseline immune status. Control data were consistent with depression of cellular immunity in the early stages (seven days) of exposure to high altitude (i.e., hypoxia), a change that was mitigated to some extent by HC pretreatment. With prolonged exposure (seven to 28 days) to hypoxia suppression of B cell immunity predominated while T cell immunity displayed slow recovery. Figures 1; tables 1; references 15: Russian.

### Neurotransmitter Action Spectrum of Morphine and Pentapeptide FK 33-824 on Cerebrocortical Neurons

917C0627A Moscow *FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian* Vol 54 No 2, Mar-Apr 91 (manuscript received 4 Nov 89) pp 11-14

[Article by V. P. Fisenko, S. A. Kasparov, Chair of Pharmacology, Therapeutic and Sanitary-Hygienic Faculties, Moscow Medical Institute imeni I. M. Sechenov]

UDC 615.212.7.015.4:612.822].076.9

[Abstract] Microionophoretic and intravenous administration of morphine and pentapeptide FK 33-824 (Tyr-D-ala-Gly-MePhe-Met-(O)-ol) to male and female 3-3.5 kg cats was shown to attenuate spontaneous and evoked neuronal discharges in the second somatosensory zone, the latter evoked by electrical stimulation of thalamocortical projections. Morphine and FK 33-824 also attenuated neuronal responsiveness to the excitatory neurotransmitters glutamate and acetylcholine, inhibited responsiveness to GABA, but did not affect responsiveness to dopamine. Responsiveness to serotonin was slightly inhibited by microionophoretic application of morphine and the pentapeptide, but intravenous administration in analgetic doses potentiated the effects of serotonin. Finally, the inhibitory effects of morphine and FK 33-824 were abolished by pretreatment with propranolol, a  $\beta$ -blocker that did not interfere with the effects of electrical stimulation, indicating the involvement of  $\beta$ -adrenergic mechanisms in the observed effects. Figures 3; references 22: 11 Russian, 11 Western.

### Effects of Calcium Antagonists on Bradykinin Actions

917C0627B Moscow *FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian* Vol 54 No 2, Mar-Apr 91 (manuscript received 1 Dec 89) pp 40-43

[Article by G. Ya. Shvarts, Ye. A. Rumyantsev, R. D. Syubayev and I. F. Fayermark, Pharmacology Laboratory, All-Union Scientific Research Institute of Pharmaceutical Chemistry imeni S. Ordzhonikidze, Moscow]

UDC 615.31:546.41].015.23]:615.225:577.175.853].076.9

[Abstract] Since bradykinin (BK) has been shown to increase the influx of calcium ions into cells, which in

turn mediate kinin action, an analysis was conducted on the effects of calcium antagonists on physiological effects of BK. Studies performed with isolated guinea pig ileum, 140-160 and 250-280 g male rats and 22-25 g male mice involved calcium antagonists representing derivatives of 1,4-dihydropyridine (nifedipine, nitrendipine, oxodipine, foridon), phenyl alkylamine (verapamil), benzothiazepine (diltiazem) and diphenylpiperazine (cinnarizine). The resultant data demonstrated that the antagonists counteracted the physiological effects of BK, with 1,4-dihydropyridine congeners shown to be particularly effective, especially foridon. These findings suggest that the anti-BF action of the calcium antagonists may be related to their therapeutic efficacy in situations involving activation of kinin mechanisms. Figures 1; tables 2; references 14: 7 Russian, 7 Western.

### Impact of Hepatoprotectors on Superoxide Dismutase (SOD) and Catalase (CT) Activities in Chronic Hepatitis

917C0630A Tashkent *DOKLADY AKADEMII NAUK UZSSR in Russian* No 10, Oct 90 (manuscript received 7 Mar 90) pp 56-57

[Article by Z. Z. Khakimov, Ye. B. Zuyeva and A. Kh. Rakhmanov, Tashkent Order of the Red Banner of Labor State Medical Institute]

UDC 616.36-002-085.355:59

[Abstract] Chronic hepatitis was induced in albino male rats by subcutaneous administration of the alkaloid heliotrin [sic] (5 mg/100 mg q. seven days for 45 days) in order to assess the effects of several hepatoprotectors on the activities of hepatic SOD and CT. Six days after heliotrin administration was discontinued the activity of CT was 65.6 percent below baseline and that of SOD was reduced by 44.8 percent. The trials involved subsequent intragastric treatment with silibor [sic], prednisolone, ziksorin [sic] or benzonal (benzobarbital) in respective dosages of 80, 2.5, 50 or 20 mg/kg for six days q. 24 h. The resultant data showed that silibor had no effect on SOD and CT activities, while prednisolone was moderately effective but the activities remained below baseline. Benzonal and ziksorin promoted recovery to and above baseline activity levels, and thus were shown to be promising agents for limiting lipid peroxidation. These observations also define a potentially new therapeutic use for benzonal. References 7: Russian.

**Organizing the Fight Against Drug Abuse in the RSFSR on an Integrated, Interdepartmental Basis**

917C0572 Moscow SOVETSKAYA MEDITSINA  
in Russian No 12, Dec 90 pp 3-7

[Article by E. A. Nogovitsyna, I. A. Nikiforov, Moscow]

UDC 616.89-008.44113-082 (470)

[Text] As directed by the RSFSR Council of Ministers, the RSFSR Ministry of Health analyzed the state of the work being done by a number of interested ministries and departments of the Russian Federation in fulfilling the 22 July 87 decree No. 305 of the RSFSR Council of Ministers, "On the Unsatisfactory Execution of Party and Government Decisions Concerning the Intensification of the Fight Against Drug Abuse."

The analysis showed that in recent years drug abuse has entered the ranks of our urgent social problems. In 1985-88, the morbidity rate associated with drug abuse rose almost 3-fold, and the rate for toxic-substance abuse rose 6.5-fold. The number of drug-abuse patients on the clinical rolls grew by 69 percent; the number for toxic-substance abuse grew 3.3-fold. At present, on the rolls in health-care and internal-affairs agencies are more than 25,000 drug-abuse patients and more than 5,000 toxic substance abuse. That social evil has especially affected the teenage and youth age groups: two-thirds of those who use drugs are 30 or under. Among the individuals newly identified as substance abusers in the last three years, teenagers constitute an average of 10 percent of the drug abusers and 45 percent of the toxic substance abusers. In epidemic regions, such as the Far East, the average annual increment of the number of substance abusers among teenagers has reached 175 percent. Sociological and epidemiological research shows that the extent of the use of narcotics and other drugs among teenagers is 15-18 percent. That evokes a justified alarm among the public: 11.5 percent of the population feels that the problems of alcoholism and drug abuse are extremely important to society.

The reasons for drug use are not clear. They have to do with flaws in upbringing, the absence of stable spiritual and moral values, poorly developed social interests, and alienation of a segment of youth from parents and educators. All that takes place against the backdrop of what is widespread among a certain segment of youth: general apathy, secularism, and a growing parasitic attitude, as well as serious problems in the organization of the population's spare time and in moral and cultural education.

In regions where narcotic-containing crops are grown (Far East, Northern Caucasus, the Volga region, and the southern parts of Siberia) those reasons are joined by specific difficulties—accessibility of raw materials for the production of drugs and the traditions that have come about in the last 30 years in their use in various forms. A definite role in the spread of drug abuse has

been played by what has been a lengthy absence of glasnost with regard to the scale of this phenomenon, plus the shortcomings in the agency-level organization of measures to fight against drug abuse and poorly coordinated efforts in that fight.

Poor drug education among youth has resulted in neutral, indifferent attitudes on the problem. A certain segment of teenagers and youths feel that the use of drugs is a matter of the individual's freedom of choice. And if the use of drugs by their peers is condemned, the attitude toward drug testing is altogether lax.

The literature's analysis of the reasons for the population's use of drugs seldom examines the psychological mechanisms underlying the process. Meanwhile, knowing them is important for developing preventive measures. Some teenagers and youths from poor homes, unable to keep up with the growing pace and loads of school programs and unable to deal well with stress, find themselves in a chronic state of mental discomfort. In searching for ways out of that state, they turn to alcohol, narcotics, and other drugs. Narcotics make it possible to achieve, without any conscious effort, a state of psychophysiological comfort, which fosters the rapid development of mental dependence. Running away from real problems into the world of illusions becomes more desirable the greater the euphoria that accompanies the use of the drugs.

At present, judging from the literature data, evaluation of drug abuse as a social phenomenon takes three approaches: (1) a sickness, (2) a form of deviant behavior, and (3) a specific lifestyle. At the same time, all three positions, taken in isolation, suffer from the same drawback—the absence of an integrated approach to the problem, which leads to incorrect conclusions in the development of organizational measures. The view that drug abuse is a sickness leads to a medicine-centered approach to solving the problem, whereas regarding it in the context of deviant behavior or as a specific lifestyle that is not sanctioned by society gives the primary role in the work to law-enforcement agencies. Facilities of other ministries and departments are relegated a secondary role as outside observers and critics. At the same time, the problem of drug abuse as a problem like any other social problem contains educational, juridical, economic, moral, and health-care aspects, among others. Solving it requires an integrated, interdepartmental, state-level approach.

From that standpoint, we evaluated the anti-drug-abuse work being done by agencies and facilities of all the interested ministries in the Kabardino-Balkar ASSR and the Kuybyshev Oblast, where teams from the RSFSR Council of Ministers went, along with RSFSR Ministry of Health workers responsible for that kind of work.

Inquiries showed that the commissions of local soviets of people's deputies for controlling drunkenness are not performing a directive or coordinating role in solving that problem. The problem is worsened by the absence in

local soviets of special funds for financing regional drug-abuse prevention programs that could be conducted through the mass media, especially television, something that is widely used in the United States, Canada, Great Britain, Sweden, and many other countries. Serious flaws exist in the work done by agencies of public education to prevent drug abuse. Inquiries showed that schoolchildren are not systematically taught about health lifestyles. In schools and vo-tech institutions, there is no one acceptable program of anti-alcohol and anti-drug education that takes into account the age and psychophysiological features of the students. Teachers do not even participate in the work associated with identifying a student "under the influence of drugs." And yet, in an examination of schoolchildren to that end, some 25 hash users were identified in just one of the schools of Nalchik of the Kabardino-Balkar ASSR. As a result, the number representing the percentage of teenagers identified as drug users is considerably below the real number of drug users, and preventive and rehabilitative work among students is only in its infancy. In 1987-88, not a single teenage drug user was identified in one out of four administrative territories of the RSFSR, and only one was identified in one out of 10. Only 10 percent of the registered students are on the internal rolls of the VUZes. At the same time, 0.8 percent of all drug users are technikum students, and 0.7 percent are VUZ students. In 1989, the number of students using narcotic-active substances grew by 24 percent.

The problem of leisure time for teenagers is an acute one. For example, in Kabardino-Balkar ASSR, the opportunities for physical activities for children are minimal. There is a 30 percent shortage of gyms, a 26 percent shortage of stadiums, and a 12.7 percent shortage of swimming pools. More than 50 percent of children's gyms don't have their own facilities, and almost a third of the schools don't have physical education programs. Playing fields in residential areas are not kept up and don't have the proper sports equipment. The situation is similar in Kuybyshev Oblast.

There are serious shortcomings in the work being done by the agencies of internal affairs. Work with individual drug users is suffering. In Dagestan, in 1988, according to the RSFSR Prosecutor's Office data, one out of every two individuals who has committed a crime associated with drugs is not on the records of the agencies of internal security. At the same time, 40 percent of those individuals had an asocial lifestyle, and every third or fourth had been in court before. Exhaustive measures are not being taken to expose marketeers and misappropriators. Thus, the portion of the "drug-abuse iceberg" that's underwater is still invisible to the public, and attacks on it have yet to bring results. A great deal of unused reserves remain in the work being done by health-care agencies. The material base of the facilities of the drug-abuse service is weak, the level of training of drug-abuse physicians is inadequate, and the effectiveness of the treatment of individuals leaves something to

be desired. No more than 10 percent of drug-abuse and toxic substance abuse patients are in remission for more than one year in most of the territories, and only 2.5 percent of the drug abusers are taken off the rolls as a result of recovery, with the figure at 2.7 percent for the toxic substance abusers. The physicians of the general treatment-prevention system have yet to "countenance" the problem and are not doing much to help the drug-abuse service identify individuals with substance-abuse problems. The directors of some health-care facilities have still not put in order the storage and use of narcotic drugs, as a result of which they continue to leak out onto the "black market," at times with no help at all from the medical workers themselves. In 1988, there was a great deal of theft and misappropriation of narcotic drugs and other strong drugs in treatment-prevention facilities and pharmacy facilities. In many cases, it was the medical workers who were guilty, and disciplinary, administrative, and criminal proceedings were brought against some 1,000 workers.

The research base for the drug-abuse service is lagging far behind in terms of meeting the needs of health care. Research is proceeding slowly in the development of an optimal model for rendering medical care to that class of patients, for studying the biochemical mechanisms of drug abuse, and for creating new drugs for treating them.

To eliminate those shortcomings, the RSFSR Ministry of Health has planned a complex of measures. The 30th five-year plan will see the construction of 39 drug treatment centers with a standard design. As early as 1990-1993, plans call for the training of an additional 1,500 drug-abuse physicians. At the same time, nearly 1,000 doctors will undergo annual updating in their specialty, and some 100 of them will focus more closely on drug-abuse problems. To strengthen the anti-drug-abuse efforts in the drug-abuse service, a division has been created in the structure of the Republic Center for Drug-Abuse Problems of the RSFSR Ministry of Health, and that division will engage in the prevention and treatment of drug abuse. Offices for the treatment of drug addicts have been opened in all administrative territories, and 110 departments and isolation wards have been set up, with a total of 1,600 beds for inpatient treatment. During the 30th five-year plan, in the epidemic regions, those offices will be open in all drug treatment centers, and their total number will be 130-140. The number of beds for the treatment of that contingent is slated to increase at least 2-fold, including beds for anonymous treatment. As early as 1990-1991, in all oblast, kray, and republic drug treatment centers, biochemical laboratories will be completed for improving diagnosis of drug abusers and for monitoring the course of their treatment. The program "Medical Aspects of the Conquest of Drug Abuse and Toxic-Substance Abuse," the development of which is being completed, calls for accelerating research on such problems and enlists the aid of 27 medical VUZes and scientific research institutes. The ministry is devoting special attention to the prevention of drug abuse among



teenagers and youth. For that purpose, in all territories, teenage drug-treatment offices have been set up, and isolation wards have been set aside for the treatment of teenagers with such illnesses. In 1988, an experiment got under way in four administrative territories of the RSFSR to work up an optimal model for the teenage drug-abuse service. Under consideration is the establishment of positions of teenage drug-abuse specialists in all interrayon drug treatment centers.

The storage and use of drugs has been placed under tighter control. Measures have been called for to provide health-care facilities with more safes for storing drugs and to install fire/safety alarm systems in the storage areas. The number of pharmacies with the right to sell narcotics has been cut to 65,000, which constitutes 44 percent of their total number. Cooperation with the agencies of internal affairs is being improved. Individuals on the rolls are checked regularly; individuals who refuse voluntary treatment are promptly registered in occupational-treatment rehabilitation centers and educational-treatment rehabilitation centers. In 1988, some 20,000 individuals underwent a course of treatment at drug-abuse service facilities, and nearly 800 drug-abuse patients were sent for mandatory treatment.

Inquiries made into the anti-drug-abuse work being done by agencies and facilities of all the interested ministries and agencies in the Kabardino-Balkar ASSR and the Kuybyshev Oblast have showed that the work is uneven and uncoordinated. Health-care and internal-affairs agencies are carrying most of the load. Thus, the causative factors are not being dealt with, but the effects of that complex social phenomenon. The victims of drug abuse are isolated from society and undergo treatment, but preventive work is poorly set up. In essence, a system of primary prevention of drug abuse is completely lacking.

From our standpoint, the fight against drug abuse should be focused on the following principal areas.

We need to set up a system for preventing drug abuse as a social problem consisting of many aspects. The guts of that system should consist of teaching the generation coming up what a healthy lifestyle is and teaching them to actively resist the harmful habits they see in their environment. Setting up controlled leisure time for children and teenagers that provides for socially positive forms of such time is aimed at solving that problem.

A second important area involves broad-based anti-drug propaganda among the adult population, with clear, convincing evidence of all the economic, moral, ethical, and juridical consequences of the use of drugs. Here we need a decisive change-over from the traditional placards and lectures that are based almost entirely on the pathogenicity of narcotics and other drugs to the use of radio and television that will take the offensive and provide a convincing explanation of the advantages of a healthy, sober lifestyle.

A third area involves comprehensive, individual work with persons who are already involved in the use of narcotics or other drugs. This area includes performing preventive measures in their families and at their work, finding them jobs and occupational rehabilitation, and creating new social and day-to-day environments as alternatives to the antisocial environments. This also includes treatment as a continuous or episodic element that is capable of keeping the individual in the framework of what society has decreed to be the social norms.

In all those areas, the work must be done on an integrated, interdepartmental basis. For that purpose, integrated plans must be worked out at the level of the ASSR Council of Ministers and the oblast and kray soviets of people's deputies for anti-drug measures that involve the participation of agencies of internal affairs, health care, public education, the procurator, culture, and athletics, as well as social organizations, with a permanent coordinating role of local soviets.

#### **Effectiveness of a Five-Year Multi-Factored Program for Preventing Ischemic Heart Disease Among Men**

917C0573B Moscow SOVETSKAYA MEDITSINA  
in Russian No 12, Dec 90 (manuscript received  
3 Sep 89) pp 57-59

[Article by T. S. Meymanaliyev, Ye. A. Shleyfer, Ya. K. Madaminov, V. Sh. Gilfanova, G. T. Ayturazayeva, Ye. M. Finger, Ch. S. Ismailova, E. K. Koshaliyev, O. S. Yaroslavtseva, and L. P. Podgurskaya; Kirgiz Scientific Research Institute of Cardiology, Frunze]

UDC 616.127-005.4-055.1-053.85-084-  
036.8-07(575.2-25)

[Abstract] Epidemiological studies in the USSR and abroad have confirmed that preventive measures allow one to stabilize and reduce illness and death from ischemic heart disease (IHD). The goal of this work was to study the effectiveness of preventive measures on two ethnic groups of men, ages 40 to 59, in Frunze. A group of 1,252 men, including 957 Europeans and 187 Kirgiz, practiced active prevention (APG), while another group of 1,534, including 1,213 Europeans and 213 Kirgiz, acted as the control (CG) in the five-year study. During the study it was determined that there is a high prevalence of primary IHD risk factors among Europeans and Kirgiz. As a result of preventive measures, the prevalence of arterial hypertension, hypercholesterolemia, smoking, and low physical activity among Europeans decreased in the APG and the CG (the decrease was less pronounced in the latter group). A similar correlation was noted among the Kirgiz. It was established that the average levels of systolic arterial pressure, cholesterol content, and number of cigarettes smoked decreased more significantly in the APG than in the CG among both the Europeans and the Kirgiz. Based on the data obtained, the authors concluded that preventive measures had a positive effect on risk factor dynamics in the



population, regardless of ethnic affiliation. The decreased prevalence of primary risk factors even in the CG among Europeans and Kirgiz was explained by public health education work conducted among the population of Frunze and the USSR Ministry of Public Health order "On Measures for Increasing Prevention of Hypertonic Disease" that was introduced in the clinics. References 5: 3 Russian, 2 Western.

#### **"MEDISTIM" Medical Center Opens**

917C0601C Kiev *RABOCHAYA GAZETA* in Russian  
13 Aug 91 p 2

[Article by V. Kreshchuk: "'MEDISTIM' Opens". First paragraph is *RABOCHAYA GAZETA* introduction.]

[Text] The "Medistim" medical center has opened in one of the wards at the "Rossiya" sanatorium. Unique equipment at the center makes it possible to treat the kidneys and improve vision.

A complex method of audio stimulation helps eliminate kidney stones and treat pyelonephritis (not in the exacerbated stage), and restore impaired kidney functions.

"Electrical stimulation of the eye," says ophthalmologist O. Klokova, "restores the strength of the ciliary muscle that is responsible for altering the curvature of the lens. Similar treatment in a central aviation hospital was recently conducted on several Soviet cosmonauts and test pilots. Now they no longer need glasses."

Treatment has been especially successful in those that wear glasses for up to 2-2.5 diopters (plus and minus), and vision has been improved in age-related changes in the retina and optic nerve.

#### **First Positron Emission Tomograph in USSR**

917C0601E Kiev *RABOCHAYA GAZETA* in Russian  
29 Aug 91 p 1

[ "'MOZG' Receiving Its First Patients"]

[Text] The MOZG center is beginning examination of patients using the first and currently only positron emission tomograph in the USSR. This device allows physicians to make an accurate diagnosis in situations where other methods used by modern medicine have not been successful.

### Radioprotective Foods

917C0503 Kiev *RABOCHAYA GAZETA*  
in Russian 3 May 91 p 3

[Article by M. Rudnev, doctor of medical sciences, professor, and director, Institute of Experimental Radiology, All-Union Science Center for Radiation Medicine, USSR Academy of Medical Sciences, and V. Malyuk, doctor of medical sciences and professor]

[Excerpt] [passage omitted] Internal radiation can be reduced by replacing radiation contaminated products with pure ones. However, an essentially large part of the food supply consists of products of domestic origin. Therefore, to reduce the intake of radionuclides with food, it is necessary to use substances that bind with radionuclides. Such substances are contained in a number of food products. For example, apple butter and unclarified apple juice contain pectins that bind with radionuclides and heavy metals. In a salad with sea kale there are alginates that absorb radioactive strontium. Many tannins and plant phenols are in dark fruit-bearing mountain ashes (rowans). These substances precipitate many radionuclides. Consumption of these products must be increased as much as possible.

Research conducted at the Institute of Experimental Radiology of the VNTsRM AMN SSSR [All-Union Science Center for Radiation Medicine, USSR Academy of Medical Sciences] has indicated that a collection of herbs under the name "Carpathian tea" reduces the radioactive cesium content in the body. Components of the collection include: Astragalus, St. John's wort, elder flowers, dioecious nettles, hawthorn flowers, linden flowers, dandelion root, peppermint, dog rose fruit, bur marigold, and elecampane. All of these are in equal portions. The preparation is as follows: add four tablespoons of the herb mixture to one liter of boiling water, allow to steep for one hour in a warm place, then strain. Take half a glass three times a day before eating.

A number of vegetables and medicinal plants improve the body's resistance to radioactivity. Among these are carrots, sea buckthorns, and yarrow. Carrots contain beta carotene, which has a strong antiradiation effect and inhibits the development of cancer. Carrots can be eaten in the raw or stewed form, with butter, in an amount no smaller than 100 g per day. Sea buckthorn berries (the orange berries are best) can be eaten as a mash with sugar (1:1) in tea or as a compote. They contain carotinoids, ascorbic acid, fat-soluble vitamins, sea buckthorn oil, and other substances that strengthen the body's resistance to radiation. The yarrow is distinguished by its radioprotective activity. Boil three tablespoons of shredded raw yarrow in one liter of water, allow it to steep for 40 minutes, and drink half a glass three times a day before eating. A hydrolyzate of sea mollusks or mussels strengthens the immune system and, as has been established at the Institute of Experimental Radiology VNTsRM, it accelerates the removal of radioactive cesium. The hydrolyzate is manufactured as the

preventive non-alcoholic beverages "Orbita," "Emiliya," "Mindalnyy Profilakticheskiy" [Mindalnyy Preventive], and "Radost" [Joy] at the Kiev Oblpotrebsoyuz [Oblast Union for Cooperative Associations] non-alcoholic beverage plant. It is recommended to drink 300-500 milliliters of one of these drinks every day.

Bee products (honey, propolis, royal jelly, etc.) are rich in biologically active components—enzymes, trace elements, vitamins, carbohydrates, lipids, and proteins. Consumption of these products increases general and radiation resistance, strengthens immunological protection, and stimulates the hemogenic system.

It is strongly recommended to eat raw garlic and onions. They contain a large quantity of bactericide-fungicide-protozoacides and antitumor substances. Therefore, these vegetables guarantee additional protection from infections that can be activated when the immune system is weakened. It has been established that with regular use of garlic and onions in food, the number of cancer cases definitely decreases.

Therapeutic-protective drinks with sodium succinate are being prepared for production. This preparation of natural origin, developed at the Institute of Experimental Radiology, is harmless, increases the body's resistance to radiation and other factors (chemical effects, oxygen deficiency), and improves physical fitness and psychological stability.

The listed antiradiation agents are effective with systematic, daily use. The indicated doses and quantities have been calculated for adults. For children, the doses are smaller and age-dependent: give 16-year-olds  $\frac{3}{4}$  of the adult dose, 14-year-olds— $\frac{1}{2}$ , six-year olds— $\frac{1}{4}$ , and four-year-olds— $\frac{1}{6}$ .

It is appropriate to briefly discuss the antiradiation properties of alcohol. Indeed, ethyl alcohol has an infinitesimal radioprotective effect. However, its effect is short-lived. With systematic consumption, the benefit from it is outweighed by serious harm that threatens one's physical and psychological health. Therefore, it cannot be recommended as a radical anti-radiation agent.

With long-term use of biologically active, including antiradiation, agents, the possible positive and negative after-effects are always evaluated. For precisely this reason, in selecting from a multitude of so-called radioprotectors, we decided on the most harmless and effective. This list, of course, is not comprehensive. Further research will enable us to widen the arsenal of antiradiation agents.

It should be remembered that the suggested antiradiation products and agents should not be contaminated with radiation themselves. If doubts arise, then they can be resolved at sanitation-epidemiological stations of the All-Union Science Center for Radiation Medicine

(Kiev), the Institute of Agricultural Radiology (Chaban settlement, Kiev Oblast) or at other establishments of a radiological nature.

### Effect of Radiation and Serotonin on Thermal Denaturation of Ribonuclease

917C0629A Tbilisi SOOBASHCHENIYA AKADEMII NAUK GRUZINSKOY SSR in Russian Vol 140 No 2, Nov 90 (manuscript received 20 Sep 90) pp 389-392

[Article by T. V. Sanaya, Georgian Academy of Sciences, Physiology Institute imeni I. S. Beritashvili]

UDC 577.34

[Abstract] The effect of serotonin-creatinine sulfate ( $10^{-3}$ M) on radiation injury to RNAase was investigated using a differential adiabatic scanning microcalorimeter to reveal why RNAase loses the ability to restore its native structure after thermal denaturation. The pancreatic RNAase solution was irradiated with a dose of 255 Gy (8.5 Gy/min). The results demonstrated that ribonuclease heat stability remains constant and equal to the non-irradiated preparation. The number of bonds cleaved between 0 and 255 Gy was dose-dependent and linear, with most of the bonds cleaved being hydrogen bonds. Experiments investigating the effect of serotonin-creatinine sulfate on thermal denaturation of RNAase showed that at concentrations of 10 mM it does not alter the thermodynamic nature of RNAase. The data suggest that serotonin-creatinine sulfate, a weak radioprotector, exerts a substantial radioprotective effect in experiments. However, the mechanism of the radioprotective effect exerted on RNAase by serotonin-creatinine sulfate is still vague, although it may be due to the capture of free radicals by serotonin-creatinine sulfate and the appearance of SH groups essential for the reduction of RNAase. In addition, the results also indicate that the radioprotective effect of biological structures by serotonin is dependent not only on serotonin-creatinine sulfate, but also on the structure of the molecules irradiated. However, the effect may also be due to the fact that intraperitoneal injection of serotonin-creatinine sulfate elicits significant vegetative and neurohormonal shifts that may mobilize other endogenous radioprotective mechanisms. Figures 1; references 5: Russian.

### Effect of Radioprotectors on Radiation-Induced Changes in Organelle-Specific Enzymes

917C0630C Tashkent DOKLADY AKADEMII NAUK UZSSR in Russian No 10, Oct 90 pp 60-62

[Article by D. Kh. Khamidov, Yu. N. Islomov, P. A. Khakimov and Zh. I. Mamutov]

UDC 577.391:577.153.3:591.81

[Abstract] Experimental clinical trials were conducted with  $3^a$ , a coordination compound of Co(III) ligand

binding vitamin U and L-Ala, to test its potential efficacy in radiation injuries. Outbred albino rats were treated intraperitoneally with 15 mg/kg of  $3^a$ , followed in 24 h by 5 Gy (0.27 Gy/sec) gamma irradiation. Blood levels of alkaline and acid phosphatases, LDH and cholesterol were monitored for 30 days. The study showed that peak elevations of the phosphatases occurred on days five to 15, i.e., at the height of radiation sickness.  $3^a$  pretreatment markedly attenuated the rise in these enzymes. In addition,  $3^a$  also attenuated the increase in cholesterol concentration and maintained LDH activity at or above baseline level in distinction to changes in irradiated control rats. Accordingly, the positive effects of  $3^a$  were attributed to mitigation of membrane damage. Tables 1; references 7: 5 Russian, 2 Western.

### Synthesis and Radioprotective Activity of 4-Alkylthioethyl Derivatives of Pyridine

917C0642A Moscow  
KHIMIKO-FARMATSEVTICHESKIY ZHURNAL  
in Russian Vol 25 No 3, Mar 91 (manuscript received 9 Apr 90) pp 27-29

[Article by V. I. Laba, A. V. Sviridova, S. A. Bolshakova, T. N. Tuzhilkova, and V. P. Litvinov, Organic Chemistry Institute imeni N. D. Zelinskiy, USSR Academy of Sciences; Biophysics Institute, USSR Ministry of Health, Moscow]

UDC 615.849.1.015.25:547.821].012.1

[Abstract] This paper presents the results of the synthesis of 4-(2-alkylthioethyl) pyridines and their acid bioxalates. The pyridines were produced by thermal joining of alkyl thiols to 4-vinyl-pyridine in a nitrogen atmosphere. The bioxalates were produced by reacting the pyridine bases with oxalate in MeOH. An investigation of the toxic properties of these compounds injected intraperitoneally into C57BL/6 mice (18-22 g) demonstrated that they are moderately toxic, with the bioxalates shown to be more toxic than the bases in general. In addition, the data demonstrated that none of the compounds were very effective when the mice were exposed to 8 Gy ( $LD_{95-99/30}$ ). However, the compounds containing propyl, butyl, amyl, hexyl, heptyl, and octyl as alkyls exhibited significant anti-radiation activity in the mice exposed to 7.5 Gy of radiation ( $LD_{84/30}$ ). The survival rate in this group ranged from 60 to 100 percent as opposed to 20 percent for the control group. The fact that the bioxalates exhibited no significant radioprotective activity is attributed to a decrease in the amount of active base in the bioxalates. However, there are other data suggesting that pyridine bioxalates are metabolized differently than bases. The data on the radioprotective effect of 4-(2-alkylthioethyl) pyridines are promising and thus indicate the need for further research in this area. Tables 2; references 4: 3 Russian, 1 Western.

**Neutrophil and Lymphocyte Dose-Response Curves in Relatively Homogenous Whole-Body Gamma Irradiation: Data From Chernobyl Nuclear Accident**

917C0673A Moscow MEDITSINSKAYA  
RADIOLOGIYA in Russian Vol 13 No 1, Jan 91  
(manuscript received 6 Feb 90) pp 29-33

[Article by M. V. Konchalovskiy, A. Ye. Baranov and V. Yu. Solovyev, Institute of Biophysics, USSR Ministry of Health, Moscow]

UDC 616.155.32/.34-001.29-02:[614.876:614.83]  
"Chernobyl"+612.112.91/94.014.482.4

[Abstract] Neutrophil and lymphocyte dynamics were assessed in over 100 victims of the Chernobyl nuclear accident who had sustained an estimated whole-body gamma irradiation in the 0.1 to 13.8 Gy range. The two month study revealed a direct dose-response relationship in the onset time of secondary neutropenia. The earliest recovery was seen in patients exposed to 6 and 7 Gy (23 days), followed by 6 and 8 Gy exposures, 9 Gy exposure, and finally 5 and 10 Gy exposures. Nevertheless, in the 10 Gy cohort neutrophil counts remained below baseline even after two months. The highest recovery rates were observed in patients exposed to 5 and 6 Gy. These findings suggest that 7 Gy appears to correspond to a critical concentration of stem cells necessary for full resumption of hemopoiesis. In addition, patients with  $\beta$ -burns ( $< 5$  Gy) over  $> 10$  percent of the body surface presented with more rapid neutrophil recovery. Lymphocytopenia was less pronounced than neutropenia and exhibited different dynamics. For example, in the 7 Gy cohort lymphocyte counts were higher than in the 4 Gy group in the three to 10 day timeframe, but all patients remained below baseline during the 60 day period of observation. In addition, as expected, the lymphocyte counts were lower in patients exposed for 1 h than in those exposed for 4 h. In general, studies on lymphocyte patterns demonstrated dynamics differing from those previously reported, an enigmatic observation that requires further attention. Figures 7; tables 1; references 20: 11 Russian, 9 Western.

**Dose Effects in Prediction of Neutrophil Count Dynamics: Cytogenetic Analysis of Lymphocytes in Victims of Chernobyl Disaster**

917C0673B Moscow MEDITSINSKAYA  
RADIOLOGIYA in Russian Vol 13 No 1, Jan 91  
(manuscript received 6 Feb 90) pp 36-38

[Article by A. A. Chirkov, A. S. Chistopolskiy and V. Yu. Nugis, Institute of Biophysics, USSR Ministry of Health, Moscow]

UDC 616.155.34-007.1-02:616.155.3-001.29]-  
02:[614.876:614.83]"Chernobyl"]-037

[Abstract] Cytogenetic studies on lymphocytes were carried out on 81 victims of Chernobyl exposed to  $\gamma$  and  $\beta$  radiation at a mean dose rate of 0.1-22 Gy/h and 0.7-9.3 Gy whole-body irradiation. The data were used to estimate the extent of hemopoietic damage and compared with the results derived from monitoring of blood neutrophil dynamics. Agreement between the two approaches was obtained in 85 percent of the patients. However, in view of the fact that numerous studies have failed to show an unambiguous relationship between the mean dose rate and total dose of  $\gamma$  radiation in the induction of chromosomal abnormalities, the mean dose rate cannot be used to predict neutrophil dynamics in patients with radiation injuries. Figures 3; references 19: 10 Russian, 9 Western.

**Long-Term Immunological Monitoring Program for At-Risk Cohorts in Chernobyl Nuclear Accident**

917C0673C Moscow MEDITSINSKAYA  
RADIOLOGIYA in Russian Vol 13 No 1, Jan 91  
(manuscript received 1 Dec 89) pp 39-42

[Article by R. V. Petrov, I. V. Oradovskaya and V. V. Pinegin, Institute of Immunology, USSR Ministry of Health, Moscow]

UDC 614.73+614.876]-07:612.017.1.083.33

[Abstract] Description is provided of the criteria employed in immune monitoring of victims of the Chernobyl nuclear accident, as developed at the Institute of Immunology in conjunctions with Directive No 261, 20/04/89, of the USSR Ministry of Health. The criteria are intended to provide a comprehensive assessment of humoral and cellular immune status and were developed jointly with the Ukrainian Ministry of Health and its various clinical and basic research institutes. The at-risk individuals undergoing monitoring are represented by pediatric and adult contingents falling into the following six categories: 1. Currently well subjects; 2. Individual with clinical signs of immunodeficiency and other forms of immunopathology; 3. Individuals irradiated at above maximum permissible levels; 4. Subjects with manifestations of "upper respiratory tract irritation syndrome"; 5. Patients with neurocirculatory dystonia attributed to Chernobyl accident factors; and 6. Patients who had been diagnosed with acute radiation sickness. References 2: Russian.

**Removal of Organic Aerosols From Incubators by Electronic Filter**

917C0605A Moscow *VETERINARIYA in Russian* No 1, Jan 90 pp 20-23

[Article by N. D. Prikhodko, A. G. Vozmilov, V. A. Zvezdin, V. M. Kuchukashvili, S. A. Minin and A. I. Sedunova, All-Union Scientific Research Veterinary Institute of Poultry Farming]

UDC 619:614.9:613.161:082.474.1:541.182.2/3

[Abstract] Vozmilov-type electrostatic precipitation filter was tested for efficiency in removal of organic aerosols from incubators employed at poultry farms. Trials with acid-treated gel, *E. coli*, micrococcus, and Marek's disease virus vaccine showed that 97-99 percent of the aerosol was eliminated after 9-12 min in a 10 m<sup>3</sup> aerosol chamber with recirculating air; 100 percent elimination was obtained after a maximum of 20 min. These findings demonstrated the applicability of such filters at poultry farms and suggests their use in other branches of agriculture. Figures 3; tables 1.

**Improved Technology for Vaccine Production From *Brucella Abortus* 19**

917C0605B Moscow *VETERINARIYA in Russian* No 1, Jan 90 pp 29-31

[Article by K. V. Shumilov, O. D. Sklyarov, N. A. Mikhaylov, and V. V. Kalmykov, All-Union State Scientific Control Institute of Veterinary Preparations, and N. D. Skichko, Shchelkovo Bioconcern]

UDC 619:599.742.4

[Abstract] Viability and immunogenicity testing was conducted on lyophilized *Br. abortus* 19 vaccine sealed in ampules under nitrogen, argon or in vacuo. The results showed that on an overall basis best results were obtained with nitrogen. After 12 months of storage at 4-10°C viability retention was on the order of 75.5 percent. More importantly, testing on guinea pigs showed that immunization with vaccine stored under nitrogen rendered 98.4 percent of the animals immunity. Tables 3.

**Experimental Gossypol-Induced Liver Pathology in Sheep**

917C0605C Moscow *VETERINARIYA in Russian* No 1, Jan 90 pp 61-62

[Article by K. N. Norbayev, Samarkand Agricultural Institute, and F. I. Ibadullayev and R. A. Ismatova, Uzbek Scientific Research Veterinary Institute]

UDC 619:615.9

[Abstract] Gossypol ingestion has been identified as a serious problem in Karakul sheep, leading to an experimental assessment of pathology induced by purified gossypol. Experimental Karakul sheep were treated intravenously with 10 mg/kg/day of gossypol in 10 ml of 33 percent ethanol until the animals succumbed (nine to 11 days). Initial clinical manifestations were observed after six to seven days, with histochemical and histopathologic examinations revealing systemic involvement. However, hepatic pathology was most pronounced and consisted of dystrophic changes with necrotic foci. Hepatic succinate dehydrogenase activity was depressed, as was the concentration of RNA and glycogen. In conjunction with staining patterns observed for alkaline and acid phosphatases these findings illustrate the profound metabolic derangement evoked by gossypol and confirm liver as the primary target organ. Figures 3.



**Indirect Hemolysis Reaction in Q-Rickettsiosis**

917C0622A Bratislava ACTA VIROLOGICA  
in Russian Vol 34 No 4, Jul 90 (manuscript received  
25 Nov 88) pp 355-357

[Article by N. K. Tokarevich, Sh. Schramek, and A. B. Dayter, Epidemiology and Microbiology Institute imeni Pasteur, Virology Institute, Slovakia Academy of Sciences, Bratislava]

[Abstract] The objective of this investigation was to evaluate the possibility of using an indirect hemolysis reaction (IHR) to detect chronic *Coxiella burnetii* infections. A *Coxiella* suspension was employed for the intraperitoneal infection of seven rabbits (2.0-2.5 kg). The animals were re-infected 120 and 240 days later, and blood sera samples were drawn at various periods for 360 days. The researchers assessed IHR specificity using sera from nine rabbits and 21 guinea pigs infected with *Coxiella*, sera from 27 patients with Brill's disease, and sera from 60 past and present victims of Q fever. The authors found that after the first infection the antibodies can be detected earlier and more quickly with IHR and indirect hemagglutination reaction than with a complement binding reaction. The negative results obtained in IHR and the indirect hemagglutination reaction 50-120 weeks after the onset of the disease confirm the experimental data obtained on animals about the relatively short period of antibody circulation. This research demonstrated that IHR is extremely sensitive and specific. However, this reaction, like the indirect hemagglutination reaction, is aimed at detecting antibodies to *Coxiella burnetii* only in phase I. One of the advantages of IHR is its ability to detect antibodies at earlier periods following infection. Figures 1; references 1: Russian.

**Detection of Antibodies to Western and Eastern Hemorrhagic Fever With Renal Syndrome Virus in Sera of Patients in Slovakia**

917C0622B Bratislava ACTA VIROLOGICA  
in Russian Vol 34 No 4, Jul 90 (manuscript received  
17 Jan 90) pp 363-365

[Article by M. Greshikova, Ye. A. Tkachenko, and M. Sekeyova, Virology Institute, Slovak Academy of Sciences, Bratislava, Czechoslovakia; Poliomyelitis and Viral Encephalitis Institute, USSR Academy of Medical Sciences, Moscow]

[Abstract] Sera were collected in 1987-1988 from patients with a clinical diagnosis of hemorrhagic fever with renal syndrome, nephritis, and/or influenza. There are two types of the hemorrhagic fever with renal syndrome virus. The western type is found in Europe and causes the milder of the two forms of the disease. It is most prevalent in *Clethrionomys glareolus* and *Microtus arvalis*. The eastern type circulates in the Far East and Asia and causes the more hemorrhagic form of the disease. *Apodemus* species of rodents are its host. Antibodies to the eastern and western types of hemorrhagic

fever with renal syndrome can be detected using immunofluorescent assay. The results demonstrated that both types of this disease have been found in small rodents in Slovakia. Tables 2; references 12: 1 Russian, 11 Western.

***Coxiella burnetii* Antigens as Inducers of Anti-Tumor Resistance**

917C0622C Bratislava ACTA VIROLOGICA  
in Russian Vol 34 No 4, Jul 90 (manuscript received  
29 Jun 89; after revision 9 Oct 89) pp 366-370

[Article by N. K. Tokarevich<sup>1</sup>, A. M. Malygin<sup>2</sup>, T. A. Kramskaya<sup>3</sup>, and O. N. Pogodina<sup>4</sup>, <sup>1</sup>Leningrad Epidemiology and Microbiology Institute imeni Pasteur, Leningrad; <sup>2</sup>Cytology Institute, USSR Academy of Sciences, Leningrad; <sup>3</sup>Experimental Medicine Institute, USSR Academy of Medical Sciences, Leningrad]

[Abstract] The objective of this investigation was to reveal the mechanisms by which immunomodifiers operate and whether immunization with *Coxiella burnetii* antigens can stimulate protection from hepatoma 22a cells. Male C3HA mice (14 g) were intraperitoneally injected with a 0.5 ml preparation of the antigen (200 µg/ml). The data showed that three hours after the *C. burnetii* antigen was administered the interferon began acting, increasing the virus-inhibiting activity of the sera, peaking at six hours, and falling to baseline at 72 hours. In addition, *C. burnetii* enhances killer activity in the splenocytes. This activity remains high for four days and then returns to normal by eight days. The results demonstrated that the *C. burnetii* antigen can induce protection against hepatoma 22a growth. The increase in resistance to tumor cells in laboratory animals is attributed to these two related phenomena. However, other mechanisms of regulating anti-tumor resistance induced by immunization with the *C. burnetii* antigen such as activation of the mononuclear phagocyte system cannot be ruled out. Figures 3; references 10: 4 Russian, 6 Western.

**Expression of HIV-1 NEF Gene Fragment in *Escherichia coli* Bacteria**

917C0644A Moscow VOPROSY VIRUSOLOGII  
in Russian Vol 36 No 1, Jan-Feb 91 (manuscript  
received 11 Dec 89) pp 17-18

[Article by M. M. Garayev, A. F. Bobkov, Tay Men Kho, and Ye. V. Kazennova, Virology Institute imeni D. I. Ivanovskiy, USSR Academy of Medical Sciences, Moscow]

UDC 578.828.6:578.56].083.3

[Text] The immunogenicity of the human immunodeficiency virus (HIV) is largely due to the structural components of the virions, products of the gag, env, and pol genes. However, the HIV genome also codes for non-structural proteins involved in regulating the synthesis of

infectious virus particles. One of these genes, *nef* (negative factor), synthesizes a protein with a molecular mass of 27 kD (p27), the antibodies to which are found in 30-50 percent of HIV-seropositive sera [3, 5]. According to data from a number of authors [2, 8], the product of the *nef* gene is a negative regulator of virus replication and probably plays a key role in establishing and maintaining the latent phase of the infection [2, 6, 8].

The presence of antibodies to p27 may be an important diagnostic trait, since in a recent study [4] it was demonstrated that some sera negative with respect to the structural proteins of HIV from individuals in risk groups may bear antibodies to p27. Moreover, the appearance of antibodies to the *nef*-protein correlates with the presence of HIV-specific sequences in the DNA of peripheral blood lymphocytes [4]. However, performing massive serological investigations for the presence of antibodies to p27 requires the large-scale production of this antigen using biotechnology methods. This study presents data on the expression of antigenic determinants of the *nef*-protein from HIV-1 in *Escherichia coli* bacteria cells.

#### Material and Methods

Experiments on the construction of recombinant plasmids were performed using conventional methods [1]. Electrophoretic assay for proteins was performed using the method described [7]. We used immunoblotting to identify virus-specific proteins [9].

#### Results and Discussion

The *nef* gene is located at the 3'-terminal end of the HIV genome and codes for a protein consisting of 206 amino acid residues [3]. Analysis of the secondary structure of this protein and previously published data indicated the presence of immunoreactive epitopes in the region of amino acid residues 45-56 and 83-95. In connection with this, we selected a 675 bp fragment of XhoI-PstI from plasmid pOR4A (Fig. 1) for expression in the bacteria cells. The pOR4A plasmid bears a 3'-terminal EcoRI-SalI fragment from the HIV genome strain BH10 [10] in which premature termination of the translation of protein p27 occurs, and thus the XhoI-PstI fragment codes for 90 amino acid residues of p27 (from the 35th to the 124th). We employed plasmid pUR292 as an expression vector [11].

Insertion of the XhoI-PstI fragment from pOR4A into the vector plasmid pUR292 at the SalGI and PstI sites results in coincidence of the frames for reading the coding sequences for  $\beta$ -galactosidase and the *nef*-protein (see Fig. 1), and consequently, the resultant recombinant plasmid, pNef33, is able to synthesize a hybrid polypeptide with an estimated molecular mass of 139,694 D, the N-terminal portion of which is represented by  $\beta$ -galactosidase, and the C-terminal portion is represented by a section of protein p27.

The data presented in Figure 2, suggest that a protein with a molecular mass of 140 kD is actually synthesized

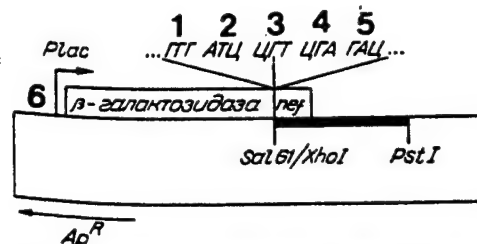


Fig. 1. Diagram of recombinant plasmid pNef33

Key: 1. GGG; 2. ATC; 3. CGT; 4. CGA; 5. GAC; 6.  $\beta$ -galactosidase

in the bacteria cells of *E. coli* HB101/pNef33, which lacks bacteria bearing the vector plasmid in its lysates.

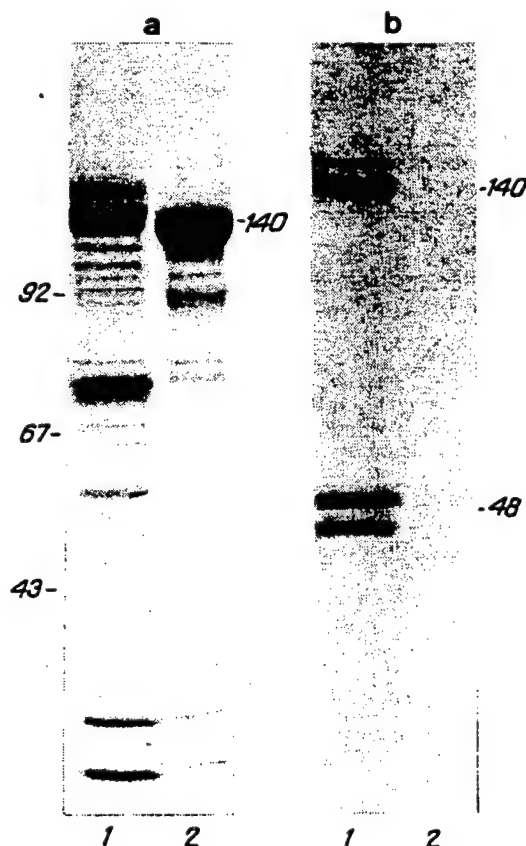


Fig. 2. Analysis of proteins synthesized under the control of the recombinant plasmid pNef33 in *E. coli* bacteria cells.

a - electrophoretic analysis of bacteria lysates; b - investigation of proteins in immunoblotting reaction. 1 - *E. coli* HB101/pNef33; 2 - *E. coli* HB101/pUR292. On the right - the size of hybrid proteins; on the left - markers (in kD).

A protein with a molecular mass of 140 kD can specifically interact with antibodies present in the blood serum of an HIV-infected person, as was demonstrated by immunoblotting (Fig. 2, b). It should be noted that in analyzing the proteins synthesized in the *E. coli* HB101/pNef33 cells, we did not once find a specific reaction with a protein with a molecular mass of 140 kD when using immunoblotting of the sera from 25 non-infected individuals (data not presented).

As Figure 2, b demonstrates, we find a polypeptide with a molecular mass of 48 kD that also reacts with HIV-positive sera in the lysate of the bacteria cells bearing the recombinant plasmid. The presence of this protein may be related to the proteolytic digestion of the hybrid molecule. Moreover, the likely site for the proteases, based on data on the molecular mass of this polypeptide, must be near  $\beta$ -galactosidase. It may be that this section of  $\beta$ -galactosidase becomes accessible to the cellular enzymes as a result of insertion of an additional amino acid sequence at its C-terminus.

Thus, as a result of this study we constructed a hybrid plasmid that synthesizes a hybrid polypeptide with a molecular mass of 140 kD bearing a fragment of the p27 protein from HIV-1 in bacteria cells. This protein is capable of specific reaction with sera from HIV-1 infected individuals, and consequently may be used for detecting antibodies to p27 in the blood of patients and carriers.

The authors express their gratitude to V. I. Apanovich for technical assistance in conducting this study.

Tay Men Kho is an apprentice at the World Health Organization from the Korean People's Democratic Republic.

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## Experimental Phytotherapy for Tick-Borne Encephalitis

917C0645A Moscow VOPROSY VIRUSOLOGII in Russian Vol 36 No 1, Jan-Feb 91 (manuscript received 16 Oct 89) pp 18-21

[Article by G. I. Fokina, T. V. Frolova, V. M. Roykhel, and V. V. Pogodina, Institute of Poliomyelitis and Viral Encephalitis, USSR Academy of Medical Sciences, Moscow]

UDC 616.831-002-022.7:578.833.26]-022.39-085.322

[Abstract] Experimental trials were performed on BALB/c and mongrel mice (8-10 g) to investigate the effectiveness of aqueous extracts of various plants in fighting tick-borne encephalitis (TBE). All of the plant extracts exhibited some degree of viricidal activity against TBE and diminished the virus titer by 2.0-6.5 lg. The results demonstrated that the extracts that almost completely inactivated TBE were from motherwort, ledum, celandine, cowberry, and European black currant plants. Viricidal activity was shown to be dependent on the dose and route of administration. The extract obtained from the European black currant was shown to be the most effective when administered by means of intraperitoneal injection 24 hours prior to infection. The data indicate that the motherwort and ledum extracts, which are effective when administered seven days before infection, contain substances that stimulate macrophage maturation, since only mature macrophages participate in the immune response. Based on results from these and other studies, the authors suggest that extracts of plants containing flavonoids and vitamin C are effective due to the synergistic effect of the latter. Tables 2; references 35: 27 Russian, 8 Western.

## Investigation of Process of pH-Dependent Fusion of Tick-Borne Encephalitis Virus With Synthetic Membranes

917C0645B Moscow VOPROSY VIRUSOLOGII in Russian Vol 36 No 1, Jan-Feb 91 (manuscript received 13 Apr 90) pp 21-24

[Article by M. F. Vorovich, A. V. Timofeyev, Yu. D. Akimova, Ye. N. Terletskaya, and L. B. Elbert, Institute of Poliomyelitis and Viral Encephalitis, USSR Academy of Medical Sciences, Moscow]

UDC 578.833.26:578.23:577.352.2]-083.2

[Abstract] The pH-dependent fusion of tick-borne encephalitis (TBE) virus (Sofjin strain) with synthetic membranes and the effect of conformational changes

within protein E on this process were investigated using cells infected with TBE virus from a grass monkey kidney. The degree of fusion between the TBE virus and liposomes was evaluated by the degree of degradation of the  $^3\text{H}$ -uridine labeled RNA virus. The results demonstrated that the degree of fusion peaked at pH 6.4 and was rather complete at this pH, 37°C, for three minutes. The authors also showed that preliminary acid treatment inhibits the fusion of virus particles with the liposomes, causing the vibrios to lose the ability to penetrate the cells. This is one reason for the diminished infectivity of flaviviruses at a subacid pH. In addition, the cleavage of disulfide bonds diminishes the ability of the TBE virus to bind with the cells. Finally, the absence of infectivity when the native conformation of protein E is upset by dithiothreitol is apparently explained by the simultaneous disturbance of two processes, the virus receptor interaction on the cell surface and pH-dependent fusion with cell membranes. Figures 1; tables 1; references 15: 3 Russian, 12 Western.

**Differentiation of Viruses in Tick-Borne Encephalitis Complex Using RNA-DNA Hybridization Technique**

917C0645C Moscow VOPROSY VIRUSOLOGII  
in Russian Vol 36 No 1, Jan-Feb 91 (manuscript  
received 18 Sep 89) pp 27-31

[Article by V. A. Shamanin, A. G. Pletnev, S. G. Rubin,  
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Department, USSR Academy of Sciences, Novosibirsk; Institute of Poliomyelitis and Viral

Encephalitides, USSR Academy of Medical Sciences, Moscow; Epidemiology and Microbiology Institute, Eastern Siberian Branch, Siberian Department, USSR Academy of Medical Sciences, Irkutsk]

UDC 578.833.26.083.3

[Abstract] Cloned fragments of DNA from tick-borne encephalitis (TBE) virus (Sofjin strain) were employed to differentiate viruses of the TBE complex and TBE virus strains on the basis of the thermal stability of the RNA-DNA hybrids. The authors noted differences in the speed of hybridization of various viruses and the relative level of hybridization of a single specimen under different conditions. The probe constructed reacted with all the TBE complex viruses except Powassan in an aqueous solution at 65°C or in 50 percent formamide at 35-50°C. These data confirm previous studies showing the great similarity of the TBE, Negishi, and Scotland sheep encephalomyelitis viruses in hemagglutination tests. In addition, a cDNA probe made it possible to differentiate TBE virus strains by the degree of similarity to the Sofjin strain. The Khabarovsk-17, Ayna, and 4,072 strains were shown to be the most similar to the Sofjin strain, and their RNA preparations hybridized well even under rigid conditions. These results indicate that it is possible to use RNA-DNA hybridization as an express test for TBE virus detection. In addition, the use of cloned cDNA makes it possible to produce DNA probes in quantities necessary for analysis. This method does not require virus purification and is suitable for the mass screening of natural isolates. Figures 4; tables 3; references 15: 3 Russian, 12 Western.

**International Conference on Biological  
Consequences of Chernobyl, at Zelenyy  
Mys-Chornobyl, September 11-14, 1990**

917C0461A Kiev VISNYK AKADEMII NAUK  
UKRAYINSKOYI RSR in Ukrainian Vol 1,  
Jan 91 pp 88-94

[Article by Yu. S. Dronzhkevich, special correspondent,  
Kiev]

[Text] The conference was held within the 30 km evacuation zone of Chernobyl AES (CAES), with the first day devoted to a plenary session in the village of Zelenyy Mys. Papers were presented by candidate of biological sciences I. M. Ryabov, deputy director of the organizing committee and chairman of the permanent Comprehensive Radioecological Expedition of the USSR Academy of Sciences (AS), as well as I. I. Pelevina, doctor of biological sciences (DBS) and laboratory head at the Institute of Chemical Physics, USSR AS, and V. A. Shevchenko, DBS and professor and department head at the Institute of General Genetics, USSR AS. Other speakers included academician R. M. Aleksakhin of the All-Union Academy of Agricultural Sciences, F. A. Tikhomirov, DBS and professor at Moscow State University, President Bush's advisor Melvin Goldman and E. V. Senin, doctor of technical sciences and deputy director of Pripyat NVO [expansion unknown] and director of the Science and Technology Center (STC) and Chernobyl International Scientific Center.

The next two days were spent in Zelenyy Mys and Chernobyl, with the participants divided into six working groups.

Forty seven reports were read at the Plant Radioecology Section, including four by foreign researchers.

The topics under consideration included distribution dynamics and migration of radionuclides in the soil-plant system, the importance and impact of geochemical factors in radionuclide redistribution in the soil and water, and general radionuclide dynamics as they apply to the 1986-1989 timespan. A number of papers concentrated on radionuclide distribution in woody plants and their relatively rapid elimination from above-ground portions of trees. Forests were found to be singularly important in stabilizing radiation levels within and without the 30 km zone, leading to recommendations that reforestation be intensified on the previously arable land.

The section also dealt with acute and chronic radiation effects at the somatic, organ and tissue levels in plants. Major sequelae were already evident in 1986, i.e., at the beginning stages of the nuclear disaster.

Other reports covered unique aspects of the effects of radiation on morphogenesis of above-ground organs of conifers and broad-leaved plants. A novel highly-radiosensitive anomaly has been reported in the relatively radioresistant birch trees.

Most of the participants were woody plant scientists who reported that major morphogenetic and somatic anomalies in woody plants were observed in 1986-1987. Currently, vegetative and reproductive repair processes predominate which suggests a promising prognosis for forests in the 30 km zone. Nevertheless, any prognosis as to the effects of radiation on forests has to be guarded and await long-term observations. It is likely that resistance to insect pests and other forms of phytopathology may have been compromised.

The section also emphasized the need for novel research techniques in forestry, particularly those that would be applicable within 10 km of CAES, as well as the need for a specialized forestry team at the Pripyat NVO.

Note was taken of the generally good work of the departments of radiology and recultivation of the STC of Pripyat NVO, and of the Comprehensive Radioecological Expedition, USSR AS. Nevertheless, the section also noted the virtual lack of research coordination between the STC and the Expedition on the one hand, and the scientists of Belorussia and the Russian Republic on the other.

The section also felt the need for greater international cooperation, with this conference representing the first step in that direction. A proposal was made to hold a coordinational conference with participation of foreign organizations as part of the 'Adjacent Forest Zone' program. Professor Sansani [sic] (FRG) suggested that donations of modern instruments be solicited for the duration of joint research programs.

The section outlined guidelines for the management of radionuclide polluted forests, particularly within the 30 km zone. Dr. H. Shodlok's [sic] (FRG) views on the role of mineral fertilizers in the accumulation and redistribution of radionuclides was particularly well received.

The scientists agreed on the need for genetic and breeding studies to produce radioresistant and highly productive woody plants, noting that such efforts have already commenced at the Department of Radiology and Recultivation of Pripyat NVO. They also emphasized the need for monitoring late sequelae of acute and chronic irradiation of plants.

Almost 40 Soviet, Swedish and German scientists participated in the 'Radioecology of Terrestrial Animals' section, dealing with radionuclide effects on wild animals. Data were presented on ecological and behavioral changes on radionuclide-polluted territories, including those related to absence of anthropogenic stress, and appropriate recommendations were proposed. Further, the initial stages of recovery were analyzed in the case of micro- and mesofauna, as well as the effects of ionizing radiation on host-parasite systems.

After extensive discussions the section prepared comprehensive recommendations and proposals for enhancing research effectiveness, information exchange, and expansion of international cooperative research projects.



Such measures are intended for Ukraine, foreign countries and radiopolluted areas of the Russian Federation. Monitoring of cesium, strontium-90 and transuranium pollutants is to continue. In particular, the participants expressed preference for a rapid method of analysis for strontium-90 that eliminates radiochemical separation.

The section also recognized the need for more detailed studies on seasonal dynamics in the accumulation and distribution of radionuclides by dominant species of wild and domestic animals. The recommendation was that plots of land be set aside for scientific and engineering studies on the effects of radiopollution on terrestrial ecologic systems and their remediation.

All agreed that expert ecological evaluation has to precede any attempts at remediation, especially any attempts at agricultural use of the territories damaged by the accident at CAES. Furthermore, there seems to be a consensus that initial attempts should involve animal husbandry.

A number of simple methods has been developed for reducing the radionuclide content in meat and other animal products. Since little is known about these advances by the population at large, the local health boards of the ministries of health of Ukraine, Belorussia and Russia have commenced a campaign to publicize such developments.

The radioecological sequelae of the Chernobyl accident for humans and aquatic flora and fauna were the topic of concern of the 'Radioecology of Hydrobions' section.

A number of bodies of water have been affected by the accident at Chernobyl. Transportation and accumulation of radionuclides in the sediments, benthos, water plants and fish contributes to the level of radiation and affects man as the end consumer of the hydrospheric food chain.

Presentations by V. Tempelton (USA), S. Fauler (Monaco), Woodhead (Great Britain) and H. Linder (Germany) confirmed the interest of Western scientists in the Chernobyl accident and their desire for cooperation with Soviet specialists.

More than twenty papers were presented at the section, dealing with the behavior of radionuclides in water bodies, accumulation in fish, and modeling of radionuclide migration in aquatic ecosystems, radiation doses, and radiation effects on fish.

Researchers have shown that despite heavy irradiation in the immediate post-accident period the most sensitive fish survived acute and chronic irradiation. Organ damage has been observed in individual hydrobionts in the cooling reservoir of CAES and in a pond in the village of Yaniv.

The scientists exhibited considerable interest in international cooperation as regards water radioecology in the affected territories of Russia, Belorussia and Ukraine. Some of the major concerns deal with radiopollution of

the food chain, ecological dosimetry of the water bodies in the vicinity of CAES, and assessment of hydrobiological and genetic consequences of ionizing radiation. A proposal has been made for joint studies on the radioecology of 'hot' particles, radionuclide transport in aquatic ecosystems, development and verification of aquatic radioecology models in polluted regions, and reconstruction and prognosis of irradiation levels of aquatic flora and fauna during explosion at the fourth reactor.

Special emphasis was placed on reducing radiopollution of aquatic food chains. The section also recognized the need for comparable research techniques and intercalibration of research methods in the USSR and abroad.

The 'Radiation Genetics' section dealt primarily with biological dosimetry and assessment of genetic sequelae in man over several generations. Soviet research on the genetics of natural plant and animal populations subjected to chronic irradiation attracted considerable attention. Methods dealing with assessment of the sequelae also generated great interest.

Important methodological and conceptual approaches to genetic consequences were presented by professor U. Ford (Australia) and doctors M. Delpouks [sic] (France), V. Borkhart [sic] (Switzerland), M. Dela Roza [sic] (Mexico) and T. Skotland [sic] (Norway). In addition, the foreign experts were impressed by Soviet efforts at evaluation of the genetic consequences of the Chernobyl accident.

The discussions led to delineation of the most promising avenues of research. These included studies on the molecular mechanisms of radiation mutagenesis and repair in human, microbial, animal and plant cells, dose-effect analysis of weak ionizing radiations as a prognostic method, and genetic effects of 'hot' fuel particles. Other topical areas included studies on adaptive phenomena in animals and plants vis-a-vis chronic irradiation, development of biological dosimetry techniques, and investigation of antimutagenesis and antimutagens in order to alleviate adverse genetic effects.

There was uniform agreement as to the need for international cooperation in assessing the genetic consequences of the Chernobyl nuclear accident and for understanding the effects of irradiation on biological systems.

The radiogeneticists advocated the creation of an international radioecology center at Chernobyl to take advantage of the existing organizational infrastructure and available expert personnel.

The 'Radiobiology' section included among its deliberations consideration of dose-effect relationships as they pertain to low-dosage radiations, nontrivial effects, and molecular, cellular, humoral and endocrine factors underlying reactions to irradiation.

Data have already been obtained on the basis of which long-term prognosis can be made. It has been shown that chronic low-dose ionizing radiation affects all levels of a biological system, and that such effects may exceed those seen with an equivalent acute dose.

The section also considered new research methods and sensitive biophysical, molecular and cellular sensors of low-level radiation. In addition, the impact of stress has also been emphasized.

One of the most important tasks consists of health risk assessment in population on radiopolluted territories. The need for detailed studies is self-evident as they form the basis for reducing adverse health effects in such settings. The consensus was to continue retrospective studies on dose load at the time of the accident, gather further information on 'hot' particles, and formulate dosimetric as well as microdosimetric assessment of the contribution of 'hot' particles to late sequelae and assess their mechanism of action.

The section noted the need for more quantitative studies on low dose-effect parameters, synergistic aspects of radiation and environmental factors, and delineation of the radiation factors in all sequelae. Additional stress was placed on understanding of late sequelae of low-dose chronic irradiation at the molecular and cellular levels and utilization of monoclonal antibodies and other probes and genetic methods in biological dosimetry. Finally, the section also underscored the need for sensitive methods for monitoring the effects of low irradiation dosages, biochemical and biophysical methods for population studies, and analysis of the molecular basis of adaptation.

The participants agreed on the immediate need for well-grounded health risk assessment criteria and predictive methodology for individual radiosusceptibility, and the need to channel research efforts into the appropriate directions.

The final decision of the section was to present the results of this conference at the All-Union Radiobiological Seminar and to propose that the Scientific Council on Radiobiology of the USSR AS coordinate radiobiological research.

The section on 'Agricultural Radioecology' noted that this field of endeavour is well developed in the USSR, Western Europe and the US, i.e., areas seriously affected by the Chernobyl accident. Consequently, reports from France, Great Britain and elsewhere were received with much interest.

A major topic of discussion concerned radiopollution of milk, meat and plant foodstuffs. The participants agreed that the problem is serious and complicated, and will persist for years to come and cannot be solved in a mere five or seven years.

At present studies on radioecology in Chernobyl largely consist of data gathering, to be followed by classification

and analysis. Modeling will have to be employed to assess agricultural ecosystems and translocation of the major radionuclides.

Although many discussions failed to end in a consensus, there was a general sense that cooperation among agricultural radioecologists of the Soviet Union, Western Europe, the U.S. and other countries and continents is a prerequisite for successful management of the problem of nuclear power in relation to ecology.

The Agricultural Radioecology section delineated the following as high priority research objectives: soil-plant radionuclide dynamics, long-term radionuclide accumulation dynamics, creation of radionuclide bulk transport models in agrosystems.

However, the most practical aspect of alleviation of the effects of the Chernobyl accident relies on limiting ingress of radionuclides into the food chain.

The section participants unanimously supported the creation of an international scientific center in Chernobyl and committed themselves to full cooperation.

At the conclusion of the plenary session G. F. Kozubov, I. A. Ryabtsev, I. M. Ryabov, V. A. Shevchenko, I. I. Pelevina and R. M. Aleksakhin summarized the proceedings and resolutions of the sections they headed.

Additional recommendations and suggestions were made by some conference participants. For example, Yu. A. Vyazovych of the Institute of Zoology of the Belorussian AS pointed out that certain areas in Belorussia, particularly in Mogilev Oblast, are as contaminated with radionuclides as the 30 km Chernobyl zone. In fact, in some cases the levels of radioactivity in Belorussia exceed that of Chernobyl. Yet these areas continue to be populated and used for agriculture. This is a situation that call for immediate resettlement.

A signal event at the last plenary session was the appearance of Zh. O. Medvedev of the National Institute of Health, London. Medvedev expressed his satisfaction that scientists from abroad were not restricted in following up their interests in the Chernobyl area and gained a better appreciation of the problems involved. Concomitantly, he expressed his dismay that most of the studies that have been conducted in and around Chernobyl have not been published and remain unknown to the scientific community.

Medvedev stated that although he cannot monitor all of the scientific journals he does follow *RADIOBIOLOGIYA* and *MEDITSINSKAYA RADIOLOGIYA*. He was concerned that he found only one report—by Hrodzinskyy from Kiev—dealing with radiation dose-effect relationship in the case of birch tree pollen. Even that study avoided mentioning that it was done in Chernobyl. Medvedev concluded as follows: "I feel that this conference opens a window through which the signal results obtained by Soviet scientists will become known to all researchers concerned with the effects of radiation

on humans, plants, animals, microflora and other environmental factors. I am impressed with the number of studies being done. I had been unaware of the extent of such efforts since the research results have been generally treated as internal ministerial reports rather than published."

Zh. O. Medvedev concluded that most of the foreign scientists present at the conference will become directly involved in studying the problems created by the Chernobyl accident.

At the close of the conference a commission was elected to prepare a summary.

The conference was closed by docent K. K. Dushutin, candidate of biological sciences and deputy director of the STC of Pripyat NVO.

The outcome of the conference was that the participants gained familiarity with the 30 km Chernobyl resettlement zone and activities of the on-site scientific organizations. ©COPYRIGHT: Vydavnytstvo "Naukova Dumka", "Visnyk Akademiynauk Ukrayinskoyi RSR", 1991.

### Immunology Conference

917C0533A Dushanbe KOMMUNIST  
TADZHIKISTANA in Russian 5 Jun 91 p 2

[Interview by KOMMUNIST TADZHIKISTANA correspondent G. Papyrina with Yu. B. Iskhaki, professor and director of the Tadjikistan State Medical Institute: "View Toward the Future". First paragraph is source introduction]

[Text] Today was the opening of the First Tadjikistan Conference of Immunologists and Allergologists. Our correspondent G. Papyrina interviews Yu. B. Iskhaki, president of this scientific society, corresponding member of the USSR Academy of Medical Sciences, professor and director of the Tadjikistan State Medical Institute.

[Papyrina] Yusuf Bashirkhanovich, we have often noted that the public health system needs radical reform. What matters of this modern field of medicine, immunology, will be discussed at the conference?

[Iskhaki] This novel science did not accidentally appear on the face of the earth during the 19th and 20th centuries. It was born from the depths of the science of infections and developed under the influence of genetic engineering, microbiology, and now ecological immunology. There have been certain advances in this field of medicine, and Tadjikistan scientists have contributed to them. We will also note that the first Nobel Prize laureate in biomedical sciences was Russian immunologist I. I. Mechnikov.

Of course, it is hard to give this science the proper attention with today's deficits in everything. But we are optimists and believe that changes will occur for the

better. For now we work, work, work. The First All-Union Immunology Conference was held two years ago, and it outlined the fields to be given the highest priority. And now we are having the first Tadjikistan Conference. The main purpose of the conferences is to define and coordinate scientific research and share experiences. We need to proceed further—towards the expansion of scientific communications and combining of efforts so that allergoses are numbered among the most serious at the beginning of the twenty-first century. But the statistics, like an epidemiological barometer, indicate deterioration of the situation at the epicenter.

What do we have at our disposal? Our scientific society encompasses more than 100 specialists in various biomedical sciences. Employees of the Tadjikistan Allergy Center offer specialized allergy care. The Central Scientific Research Laboratory became one of the science centers for problems of immunology and allergology. During the past five years the scientific potential of the society has risen due to five doctors of science and 16 candidates of science trained at the Tadjikistan State Medical Institute and the Gastroenterology Scientific Research Institute, Tadjikistan Academy of Sciences. At the medical institute alone, various aspects of immunology are being researched in 32 comprehensive investigations.

This explains why we were the first to hold such a representative forum. People in the Soviet Union as well as abroad are interested in our studies. We do have something to show our colleagues. Several reports were sent to the Worldwide Congress of Allergologists in Japan. We are also participating in the scientific conference "Ecological Problems of Immunology" to be held in Perm. We received a personal invitation to an immunology symposium in Jerusalem. It will be held in July 1992. People know about our research and want to hear about our investigations, which lends confidence to our work.

[Papyrina] I see a brochure on your table with a long list of works by the colleagues at the medical institute. Do they focus on this same problem?

[Iskhaki] Yes, this bibliography presents information on scientific research in the field of immunology and allergology. It lists books, articles in journals and collections, data, and theses from conferences. Dissertations defended by institute colleagues are in a separate section. Incidentally, this edition has been timed to coincide with the first congress. Three different directions will be discussed at it. Immunity and the outside environment. Clinical immunology. Modern problems of allergology.

[Papyrina] Who are among the guests of the conference?

[Iskhaki] We have a strong bond and cooperation with scientists from many cities of the Soviet Union, so we invited representatives of the scientific world from 13

republics. They include the well-known names of academicians R. V. Petrov and A. D. Ado (Moscow), N. D. Beklemishev (Alma-Ata), V. P. Lozovoy (Novosibirsk), and others.

[Papyrina] Could you describe in greater detail the works of our scientists? What, in their opinion, predetermines our diseases, and what do people need to know about themselves in order to overcome them?

[Iskhaki] I will put it this way in order to make it clear: each person has an immune status that protects him from diseases. When it is upset, the body is unprotected and vulnerable. This is why it is important that the immune system functions normally. And if it has already been upset it must immediately be restored. How? We can use drugs, a selection of the genetic code, or the effect of natural factors to act on the immune status.

And we are doing this. We have conducted immunological research on healthy adults and children in Dushanbe, Ziddy, Murgab, and Tursunzade. The analysis demonstrated that the immunological readings in industrial zones were subject to seasonal fluctuations. The immune status of children in the village of Ziddy was excellent.

We are now finding that the frequency and aspects of the manifestations of allergies are related to a large degree to the ecological situation. Asthma may be caused by more than 200 commercial allergens. Hundreds of new chemical compounds, asthmogens, may appear in the future. Our scientists are successfully dealing with immunological forms of bronchial asthma. A high-altitude immunology laboratory has been founded under the direction of professor N. Berdiyev at the Anzob Pass. Asthma patients hike to the village of Ziddy. The mountain air benefits the body and is therapeutic. After treatment they have a bright point in their life, or as we say, they go into remission. The use of the Khodzhaobigarm health resort for immunorehabilitation is also promising.

So today we can discuss the need for goal-oriented immunotherapy and continuing research in this direction.

[Papyrina] Metaphorically speaking, you cannot treat the leaves of the tree without paying attention to its roots. Is the immune system the "root" of the body?

[Iskhaki] I would say more: we have not even scratched the surface of the possibilities for healing that immunology offers. Today progress in medicine is relying even more on the unstudied problems of immunology. Without it we cannot achieve significant results in the treatment of many diseases. It is not only the physicians who know that the fight against the cancer cell in the body is led by the immune system. Take the plague of the twentieth century—AIDS. Its virus affects primarily the human immune system.

[Papyrina] What is the future for this science?

[Iskhaki] We need to take immunology to a new level of development and discovery. This science began centuries

ago. Now there are entire scientific schools. But reality is such that not enough attention is paid to its problems. Today's immunology needs a modern equipment base. But how can it be developed with the poverty of our public health, the huge budget deficit and the lack of hard currency. After all, the best equipment of this type is manufactured in Japan, Finland, Sweden, and the USA.

Nevertheless, we need to develop a system for the immunological support of public health so that the immunologist can be at every polyclinic and can make a diagnosis for any patient and treat him with consideration of the aspects of the immune system. Furthermore, we need centers for clinical immunology, a network of immunological laboratories, and consultation and rehabilitation clinics. Immunology is on the forefront today, and we must not forget that. The key to solving many problems of practical public health, and especially in mother and child protection, is in the hands of the immunologist and allergologist. This is the medicine field of the future, and if we invest sufficiently in it, we will return health to the people.

[Papyrina] Thank you for the interview.

#### **All-Union Seminar "Induced Resistance of Crops to Phytopathogens"**

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ZHURNAL in Russian Vol 53 No 1, Mar-Apr 91  
(manuscript received 21 Jun 90) pp 104-106

[Article by L. V. Kolesnik and I. P. Zhuk]

[Text] The All-Union Scientific-Practical Seminar "Induced Resistance of Crops to Phytopathogens", which was organized by the All-Union Scientific Research Institute of Plant Protection (AUSRIPP) and Rostov State University with the help of the Republic Kabardino-Balkar Plant Protection Station, was held 20-22 September 1989 in Prielbruse (Kabardino-Balkarskaya ASSR). Sixty-eight representatives of the Ministry of Higher Education Institutes, the All-Union Academy of Agricultural Sciences imeni V. I. Lenin, the Academy of Sciences for the USSR and the union republics, and commissions on provisions and purchases participated in the seminar.

Three reports were given at the plenary session and 25 communications were presented in section sessions at the seminar; 41 standing reports were discussed.

Professor Yu. I. Vlasov (AUSRIPP, Leningrad) spoke at the plenary session about his report on problems of induced resistance in phytomycoplasmology. He presented a group of measures in his report aimed at inducing resistance to big bud in tomatoes. It includes fighting the carriers (with chemical and agricultural methods), early planting of early varieties of tomatoes, inducing earlier maturation of the fruit with imanine [sic], and inducing resistance by treatment with steroid glycosides. Since plants are often affected by mixed infections (for example, those elicited by mycoplasmas



and viruses), measures for controlling VTM [as published], including induced resistance to a virus, will be useful also in combatting big bud in tomatoes.

O. A. Monastyrskiy (North Caucasus Phytopathology Scientific Research Institute, Krasnodar) elaborated on the status of chemical immunization of plants and perspectives for protection from phytopathogenic microorganisms in his report, particularly for inducing resistance in grains to rust fungi by means of biotic and abiotic factors (elicitors). Although the mechanisms of induction of protective reactions in plants are vague and possibly varied, a specific response of plants to the effect of elicitors is also found in the lignification of induced cells, the synthesis of phytoalexins, and a number of novel proteins, fatty acids, and polysaccharides. The report emphasizes the need for more research on the development of the fundamentals of chemical immunization of plants, the development of the basic requirements of elicitors used for practical purposes, as well as the directed search for substances with high elicitor activity. The use of gene engineering to insert phytopathogenic microorganism genes that code for the synthesis of substances with high elicitor activity into plant cells merits special attention.

In his report, S. L. Tyuterev (AUSRIPP, Leningrad) discusses the basic protective mechanisms of plants, inherited factors and particularly induced immunity, as well as paths for their stimulation and active use in order to enhance the disease-resistance of the plants. The nature of induced resistance is still not fully understood. It is the author's opinion that many plant-host metabolic reactions are clearly involved in its formation (the synthesis of proteins, nucleic acids, and phytoalexins; changes in energy, oxidative, and carbohydrate metabolism; rearrangement of a number of enzyme systems, the accumulation of antibiotic constitutive substances of secondary origin, etc.). The result of these reactions in plants with induced resistance is the accumulation of pathogen inhibitors in them, proteins, including enzymes, that control resistance, phytoalexins, as well as phenols and their oxidized forms. Stimulation of protective mechanisms under the influence of infectious and non-infectious substances of a biogenic and abiogenic nature, as well as inhibition of them with actinomycin D indicate that induced resistance is governed by the plant host genome to a large degree. Biochemical markers of induced resistance (proteins, phytoalexins) may be used in breeding programs for immunity in order to accelerate the selection of perspective hybrids. Based on his own and published data, the author advanced a hypothesis about the nature of protective reactions of plants upon vaccination against viruses, according to which the biosynthesis of RNA and protein of the host and pathogen in the infected tissues plays a leading role; the newly formed proteins probably control not only localized viruses, but also their transport. The author concluded that the search for biopesticide substances that induce localization of systemic infections as an ecologically safe means of crop protection is promising in practice.

In our opinion, the following reports among those heard at the section meetings were noteworthy.

V. G. Reyfman and S. A. Romanova (Biology-Soil Institute, Far East Department, USSR Academy of Sciences, Vladivostok) reported on the use of microelements, heavy metal salts, steroid glycosides, pancreatic RNAase, and endonuclease from *Serratia marcescens* as inducers for increasing plant resistance to VTM and KhVK [as published]. It was suggested that in this instance, acquired resistance of the plants to infection is a result of artificially induced activity of RNAase in the plant, which inhibits viral RNA by impairing its ability to replicate.

The report of I. T. Lakhmatovaya et al. (Moldavian Scientific Research Institute of Fruit Culture, "Kodru" Scientific Production Association, Institute of Ecological Genetics, Moldavian SSR Academy of Sciences, Kishinev) emphasized the role of secondary plant metabolites, steroid glycosides, as inducers of plant resistance to viral infection. We know that viral infection causes significant changes in plant metabolism, particularly in the protein composition of infected cells and the oxidation-reduction processes that occur in them (accelerates the peroxidation of unsaturated lipids which compose the biomembrane). Steroid glycosides have antioxidant and antiviral effects. The enhanced resistance of plants to viral infection after treating them with steroid glycosides apparently occurs due to amplification of the protective reactions of the host plant (enhanced activity of ribonuclease, a key enzyme in the cell) and alterations in the protein composition of the cells.

The results of research by T. S. Fominye et al. (AUSRIPP, Leningrad) also suggest that moistening tomato and pepper seeds in solutions of varying concentrations of steroid glycosides in order to increase their resistance to viral diseases is beneficial (increased germination of the seeds and a five to seven day delay in manifestation of symptoms as compared to control were noted).

V. G. Parshin and L. M. Bondareva (Rostov State University) reported on the effect of para-aminobenzoic acid (PABA) at the level of peroxidase activity in cucumber plants. They demonstrated that treating the vegetative cucumber plants by pouring and spraying with a 0.001 percent solution of PABA results in enhanced resistance of the plants to infection with green spotted mosaic virus, which is accompanied by an increase in peroxidase activity, a factor which correlates with plant resistance to stress situations, including viral infection.

Reports by T. N. Teploukhovaya and T. A. Yakutkina (AUSRIPP, Leningrad) and F. Ye. Kozar et al. (Ukrainian Scientific Research Institute of Agricultural Microbiology, Chernigov) were devoted to the use of slightly pathogenic strains of viruses under conditions of protected soil with the objective of vaccinating plants (tomatoes against tomato mosaic virus), as well as X- and M-viruses for protection of susceptible varieties of potatoes from infection with pathogenic strains of these viruses under conditions of a highly infectious background, respectively.



A. L. Boyko et al. (Kiev State University) presented in their report methods that they developed and recommend for evaluating the virus resistance of perspective sunflower varieties and hybrids.

L. V. Kolesnik (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) presented some biochemical and ultrastructural aspects of natural and induced resistance of sugar beet plants to cucumber and beet mosaic viruses that suggest that there is a difference in the mechanisms of induced systemic resistance and localization of the virus. It was concluded that underlying the symptomatic resistance of the sugar beet is the ability of the plant to utilize its constitutional and physiological mechanisms of virus resistance which finally results in limiting the intercellular and systemic transport of the virus infection. I. P. Zhuk and A. D. Bobyr (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) reported on methodical approaches for producing somatic clones of the sugar beet resistant to beet mosaic virus. Testing for beet mosaic virus resistance of morphologically normal clones in two varieties of sugar beets demonstrated that most of the regenerants were susceptible to this virus; however, relatively and highly resistant regenerant plants were also identified.

At the conclusion of the seminar's work a resolution was adopted in which the urgency and sense of periodic all-union seminars on the problems of biological and chemical immunization of plants was emphasized.

The seminar participants expressed gratitude to the Rostov State University and agency committee for their substantial work in organizing and successfully holding this seminar, the first conference in the country devoted entirely to the problems of induced resistance of plants to phytopathogens.

**All-Union Conference "Anthropogenic Ecology of Micromycetes, Aspects of Mathematical Simulation, and Environmental Protection"**

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[Article by N. N. Zhdanova, L. A. Zakordonets, and V. L. Ayzenberg]

[Text] The All-Union Conference on the Ecology and Physiology of Soil Micromycetes was held in Kiev 17-19 April 1990. More than 200 scientists from 53 scientific institutes in 28 cities of the Soviet Union were involved.

Academician V. V. Smirnov, director of the Institute of Microbiology and Virology imeni D. K. Zabolotniy, Ukrainian SSR Academy of Sciences, gave the opening address at the conference.

Work was conducted in four sections: "Anthropogenic Ecology of Micromycetes and Environmental Protection," "Mycodegradation," "Physiological and Biochemical Aspects of Resistance and Adaptation of Micromycetes to Anthropogenic Factors," and "Mycobiota in Various Ecosystems." The curators of the conference sessions were D. G. Zvyagintsev, B. A. Tomilin, I. A. Dudka, N. P. Yelinov, V. G. Dzhavakhiya, S. A. Simonyan, Kh. N. Orazov, V. F. Smirnov et al., well-known specialists in the field of mycology and ecology.

Reports were presented in the first section that detailed the ecological situation within a 30 km area of the Chernobyl Nuclear Electric Power Plant. Yu. A. Kutlakhmedov's report (Botany Institute, Ukrainian SSR Academy of Sciences, Kiev) was devoted to investigating the changes among higher plants, particularly among softwoods. A consistent rise in the accumulation of radionuclides in the plants was noted (in 1987 it was 3-7 percent of the dry weight, in 1988 it was 20-24 percent). In assessing the situation one must consider the "spotty" nature of radioactive fallout. The aspects of the biological effect of small doses on higher plants were discussed.

In his report Ya. I. Serkiz (Oncology Institute, Ukrainian SSR Academy of Sciences, Kiev) discussed matters of the effect of small doses of radiation on animals. The author reaches a conclusion on the unique nature of the effect of radiation from the Chernobyl accident on them.

A report by N. N. Zhdanova et al. (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) was devoted to problems of change in the complexes of soil micromycetes in 1986-1989. A high degree of autonomy of the mycobiota that formed in radionuclide-polluted soils was found and was shown to depend on the level of radioactivity, the depth of the soil horizon, and the time of year. The rearrangement of fungal complexes occurred due to the dominance of melanin-containing species in them. The species isolated were characterized by high adsorption activity with respect to  $^{90}\text{Sr}$  and  $^{137}\text{Cs}$  ions.

With the use of a method of membrane chambers (O. Ye. Marfenina, Moscow State University) it was possible to observe ontogenesis of predetermined fungus strains, including those of anthropogenic origin, in control and stress conditions. The latter affect the growth of spores and the development of mycelium, and result in curtailing the ontogenesis of fungi.

In his report, N. S. Panikov (Institute of Microbiology, USSR Academy of Sciences, Moscow) convincingly illustrates the use of mathematical models for investigating the physiological status of micromycetes that develop in adverse conditions: with a deficit of biogenic elements in the medium and exposed to radiation and extreme temperatures. On this same note was a report by Ye. N. Gromozovaya et al. (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences) performed using the ascomycete *Thielavia* species.

Individual aspects of the metabolism of heat-pigmented micromycetes are detailed in a report by L. N. Ten, N. N. Stepanichenko et al. (Tashkent State University, Tashkent).

A report by O. N. Nikolayev et al. (All-Union Scientific Research Institute of Phytopathology, Moscow) was devoted to investigation of antioxidant properties of the phytopathogen *Pyricularia oryzae*. A position was formed on the complex nature of the antioxidant protection reaction in the fungus, including melanin and the respective enzymes.

Upon comparative investigation of the non-pigmented mutant *Cladosporium cladosporioides* and a wild strain, the effect of melanin on the growth rate, the level of endogenous respiration, the structure of the respiratory chain, the reaction to light, and resistance to prolonged starvation was established (L. G. Borisyuk, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences).

Professor N. M. Chernova (Soil Science Institute, Moscow) lectured on the basic direction of the rearrangement of complexes of microarthropods—mycophages with anthropogenic stresses on the soil.

A number of reports were devoted to matters of ecological prognosis and monitoring.

Professor I. A. Dudka et al. (Botany Institute, Ukrainian SSR Academy of Sciences, Kiev) reported the results of complex investigations of a phytotrophic mycobiota aimed at developing mycoindication of phytosystems at various levels of organization and anthropogenic stress. V. N. Borisova (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) proposes the use of a group of *Hyphomycetes*, organisms that degrade plant waste, as a model specimen for indication of the status of forest ecosystems. Such indication is a qualitatively new stage in ecological prognostication. The use of a systemic approach and methods of indication at the cellular level for evaluating anthropogenic effects on the soil were demonstrated in a report by L. V. Popova (Moscow State University, Moscow).

V. I. Krutov (Forestry Institute, Karelian Branch, USSR Academy of Sciences, Petrozavodsk) presented data on the development of a system of measures to limit the massive spread of pathogenic micromycetes in forest nurseries of Kareliya and Murmanskaya Oblast.

A wide range of problems concerning the physiological and biochemical properties of mycodegraders that develop in extreme situations of industrial econiches was discussed at the section on the problem of mycodegradation.

Based on criteria such as the hydrophobicity of the surface and the size of the surface charge of the "fungus—optical glass" system, the possibility of creating fungus-resistant anti-static coverings was realized (E. Z. Koval et al. Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev). The specific mechanism of the effect of fungicides on micromycete lipases was established in the degradation of natural

triacylglycerides (V. F. Smirnov and A. N. Leontyeva, Gorkiy State University, Gorkiy). A new strategy for protecting lubricants and cooling fluids from mycodegradation was proposed with consideration of the physiological properties of the mycodegradation agents (Z. M. Kartavtseva, KamAz, Naberezhnyye Chelny). Information on the specific composition and mechanisms of the action of micromycetes that affect museum ceramics was presented in G. M. Novikovaya's report (GNIRKhM [as published], Ministry of Culture, Ukrainian SSR Academy of Sciences, Kiev).

Standing reports were devoted to problems of the development of physico-chemical methods of investigating the processes of mycodegradation (S. A. Ivanova and L. P. Sidorenko, Scientific Research Institute of Microinstruments, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev), investigation of the lipolytic ability of biodegrading micromycetes (V. L. Ayzenberg, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev), and investigation of fungi contaminating chitin in extreme conditions of technological processes (Ye. S. Kharkevich, T. M. Moskalenko, and T. G. Sakharova, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev; Dalrybvntuz, Vladivostok). Also detailed were problems of micromycete adaptation to functioning on complex substrates under the influence of anthropogenic pressing (R. Ye. Pashkevich and V. I. Dakhnovskiy, as well as T. I. Redchits, E. Z. Koval, and V. A. Zakharchenko, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev).

A number of reports were presented in the third section on the investigation of physiological and biochemical fundamentals of adaptation and resistance of micromycetes. Thus, N. Ye. Yelinov and L. A. Kossior (Chemico-Pharmaceutical Institute, Leningrad) hybridized a producer of the aubasidan [sic] polysaccharide with other strains of the species *Aureobasidium pullulans* by means of protoplast fusion. The authors reached a conclusion about the relatively low degree of homology between the fungi in question. Detailed research was performed on the physiological and biochemical parameters of *A. pullulans* (N. A. Yurlova, Chemico-Pharmaceutical Institute, Leningrad), and a high level of adaptation of the fungus to these conditions was found.

Ye. P. Feofilovoy et al. (Microbiology Institute, USSR Academy of Sciences, Moscow) investigated the mechanisms of heat-adaptation in mycelial fungi. The authors discussed the protector properties of reserve compounds of fungus spores in connection with their increased ability to adapt to change in cultivation temperature as well as resistance to stress factors.

T. A. Belozerskaya et al. (Biochemistry Institute, USSR Academy of Sciences, Moscow State University, Moscow) reported on the significant heterogeneity of the photoelectric reaction in individual fungal mycelium cells. It was found that isolated cells of the fungal hypha were not capable of growth; a group of three to four cells

is necessary for this. The energy dependence of apical cell growth on the adjacent mycelium cells was demonstrated for the first time.

N. R. Ozolinya et al. (Wood Chemistry Institute, Latvian SSR Academy of Sciences, Riga; Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) reported on the use of microscopic fungi capable of utilizing and neutralizing various wastes from the paper and hydrolysis industries with the objective of developing environmental protection technology.

The use of ultraviolet radiation for producing highly productive mutants of *Penicillium canescens* Sopp. made it possible for A. K. Tseretel et al. (Plant Biochemistry Institute, Georgian SSR Academy of Sciences, Tbilisi; Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) to produce a wide spectrum of cultures distinct in their cultural and morphological traits and level of carboxylase biosynthesis.

A number of reports were presented at the conference on the various aspects of toxin production in fungi and their potential danger to the environment under conditions of various anthropogenic factors. A number of reports were devoted to macrocyclic trichothecins (MCTC), particularly problems of the abundance of representatives of *Myrothecium*, *Dendrodochium*, and *Stachibotrys* in nature, evaluation of their toxigenic potential (A. M. Zaychenko, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev), and some new aspects of biochemical mechanisms of the effect of MCTC (T. I. Tugay, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev). Based on the data presented, the authors concluded that the ability to produce MCTC is a property common to the micromycete representatives studied.

A report by R. A. Maksimovaya et al. (Moscow State University) details changes in the biological properties of micromycetes, producers of fusaric acid and trichothecins, during treatment with ultraviolet light and surfactants.

Problems of the contamination of various industrial substrates with toxin-producing fungi under conditions of anthropogenic stress were discussed by T. V. Fadeyeva et al. (KazNIVI [as published], Alma-Ata). Data on the dissemination of feed and canned fruit and vegetables with potentially toxigenic strains of fungi were presented in standing reports by G. P. Lemeshchenko (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) and A. G. Batikyan and L. L. Osipyan (Yerevan State University, Yerevan). A. G. Subbota (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) presented a rapid method of indication of mycotoxins with the use of *Tubifex tubifex* along with previously known *Staphylococcus aureus* 209 and *Chlorella vulgaris* as test specimens.

In the section "Mycobiota in Various Ecosystems", a report was given by Ye. G. Vedenyapina and B. A. Tomilin (Botany Institute, USSR Academy of Sciences, Leningrad) on the adaptation of phytopathogenic fungi to

pesticides, which increases the diseases in plants and decreases the yield. K. D. Titova and I. N. Ivanova (All-Union Scientific Research Institute of Phytopathology, Moscow Oblast) presented the results of research on the change in the specific structure of a population of the etiological agents of tracheomycosis [sic] wilt in wheat in connection with the use of fungicides for pre-sowing treatment of the seeds, which upsets the ecological equilibrium. I. A. Ellanskaya et al. (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev; Forestry Academy, Leningrad) reported on the aspects of a mycobiota of bark composts as sources of organic fertilizers for agricultural and forestry crops. A large number of mesophilic heat-tolerant and thermophilic species of fungi that colonize the bark of deciduous and conifer species were observed. D. A. Shtok (Microbiology Institute, Uzbekistan SSR Academy of Sciences, Tashkent) reported on the changes in the composition of the structure of the complex and population of micromycetes in soils of cotton monoculture fields.

In their standing report devoted to the effect of anthropogenic factors on aspects of the species composition and population dynamics of the etiological agent of the common root rot in grain crops, L. A. Ashmarinaya and V. A. Chulkinaya (Siberian Scientific Research Institute of Agriculture and Adoption of Chemical Methods in Agriculture, Siberian Department, All-Union Academy of Agricultural Sciences imeni V. I. Lenin, Krasnoobsk, Novosibirsk Oblast) noted a change in the population of the etiological agent of this disease in nature and in agrophytocenoses. Yu. M. Voznyakovskaya and A. K. Nikanorova (All-Union Scientific Research Institute of Agricultural Microbiology, Leningrad—Pushkin) presented data on factors governing the level of soil fungistasis and their role in protecting plants from root rot. T. B. Aretinskaya, L. A. Zakordonta, S. M. Suprun (UCKhA [as published], Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev), and M. L. Aleksenitser et al. (USKhA, Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) discussed the use of fungal biostimulants (fusamine [sic], fusarol [sic], and others) in sericulture in their reports.

A standing report by Yu. V. Lizak and I. P. Kozinets (Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences, Kiev) was devoted to the problem of biotransformation of chicken manure into feed by micromycetes.

At the concluding session of the conference, an initiative proposed by the Institute of Microbiology and Virology, Ukrainian SSR Academy of Sciences with respect to the organization of a second conference on the extreme ecology of fungi was approved. The majority of the speakers emphasized the timely nature of organizing the conference and conditions of the deteriorating ecological situation and expressed the desire for such conferences to become a tradition.

The participants noted the high quality of the reports and communications presented, as well as the excellent organization of the conference, which made it possible to establish and expand the scientific contacts of mycologists from different regions of the country.

**Soviet Scientists Trying to Break Into World Market***917C0534A Moscow IZVESTIYA in Russian  
31 May 91 p 6*

[Article by B. Kononov, Science Commentator for IZVESTIYA: "Price of Intellect. How Soviet Scientists Are Trying To Break Into World Market"]

[Text] While the Soviet Union is breaking into republics and oblast "fences," the rest of the planet is shattering the process for forming a common scientific-technological space. And our best scientists are taking desperate efforts in order to obtain a place on this "train" that is gaining speed.

The dissemination of information on research results and the periods for converting these results into actual industrial technology are also rapidly growing and gaining speed. The one who can get his new technology to the commercial market sooner takes all the cream of economic success. Therefore, information on scientific and technical innovations becomes even more valuable.

Taking over the slow, paper scientific journals, when up to a year (or more in the Soviet Union) may pass between the delivery of the article and its publication are the electronic journals, for which this period is reduced to a week. The content is entered into electronic data banks, and upon the user's request, the information in question is printed on his personal computer, literally within minutes. This network is becoming even more branched. Even today, a national service of scientific and technical information in the USA Ministry of Trade has 1.5 million electronic users.

And now even the Soviet Union is being included in this electronic structure. Moreover, the original and edifying form of "introduction" to the American information technology market was selected. A company "Science Information Express Data" was founded in the USA. This is an American company, but 11 of its 12 directors are Soviet scientists that represent various organizations of a biotechnological profile. For now this company is specializing in biotechnology, one of the most dynamic modern fields of knowledge and one which has vital significance for the Soviet Union. A contract has already been signed for transmitting three Soviet electronic journals to the USA.

"Our chief purpose," says Professor S. Varfolomeyev, president of this company, "is to join the world current of scientific information and planet-wide transportation technology. In the USA, studies in the field of biotechnology are more developed, and for us, access to American data in exchange for our information plays an extremely important role. We must also obtain the hard currency we need.

The executive director of the firm, American businessman D. Pales, also hopes to make a profit on the sale of Soviet scientific information. He believes that for now there is no shame in using the American companies free

of charge. And he himself is planning to defend the interests of the Soviet scientists who do not yet know the American market and could be taken advantage of. On the other hand, a well-known American law firm directed by D. Kanklom, which is now working out of a "sporting interest," has been hired to protect our interests and expertise in all contracts. They are counting on positive dividends in the future.

I was fortunate enough to attend the first "business seminar" of the new firm held in May in Washington. In contrast to the large exhibits and conferences that are currently fashionable, this meeting was modest. Seven noteworthy Soviet scientists related the results of their research. Only representatives of the American firms were present in the small room. They had previously been familiarized with the agenda of the seminar and expressed interest in obtaining the technology being discussed. In the lobbies and at lunch everyone was able to make agreements on the development of contacts and obtaining more detailed information prior to signing the contracts. This was really a business meeting, and it is believed that they will be held fairly often in various cities in the USA with rotation of the Soviet specialists and American firms.

A report by M. Kirpichnikov, director of the Department of Perspective Biotechnology of the USSR State Committee for Science and Technology, on the scope of fundamental biotechnological research in the USSR that is being conducted within the framework of four government programs made a great impression on the American participants at the first meeting.

Unfortunately, even participation in government programs will in no way solve all of the problems for supporting the leading research projects, although it is very important to Soviet laboratories. In the evening we spoke frankly with the scientists at the hotel about this situation, and I would like to share with the public their extreme concern for the fate of our science.

"One after another colleagues are beginning to come and tell me that they must soon cease their experiments," says deputy director of the of the Physical and Chemical Biology Institute in the presence of A. Bogdanov, Moscow State University Corresponding Member of the USSR Academy of Sciences. "We don't have the basic reagents. Our industry does not manufacture them. We do not need very much hard currency, just 15,000-20,000 dollars per year, but they are not giving it to us like they did before. We have been working with outdated equipment for three to four years. Without the reagents it will be the end. The only thing that is keeping many of our scientists from emigrating is that here in the Motherland they can conduct interesting work, in spite of all the difficulties of daily life. The currency starvation now has us by the throat. It was very difficult for molecular biology and genetics to stand on its feet after the black epoch of Lysenko, and now our science is again in danger. There are three to four "locomotives" in each laboratory as a rule, and then there is one. If they leave, it will be the creative death of the collective. And the



West will gladly take our specialists in the field of molecular biology. This means that we need to utilize all of our resources in order to adopt hard currency self-support and preserve Soviet science.

"Just last year," echoes V. Debabov, director of the All-Union Scientific Research Institute of Genetics and Breeding of Commercial Microorganisms and USSR Academy of Sciences corresponding member, "the Ministry of the Medical Industry, to which our organization is subordinate, owed the collective five million rubles. This year they added one million rubles more to this debt. Now the Ministry is bankrupt, which means we will not get this money. The government is forming plans, outlining research, and... deceiving us. At the same time, they have not yet passed a law on intellectual property. What we need is goods that need to be paid for with money. But we do not produce goods. It is so absurd! The only escape for us is to sell our technologies abroad, where they are considered goods. This institute is large. We need 500,000-600,000 dollars a year to support research. We have already come out on the Japanese market, and now we are trying the American market..."

"We can no longer be a 'dog on the hay'", affirms VASKhNIL [All-Union Academy of Agricultural Sciences imeni V. I. Lenin] academician I. Atabekov, well-known virologist and USSR Academy of Sciences corresponding member. "After all, we have barely implemented the least bit of knowledge that has been gained, and the rest is simply aging. But in the USA almost all worthwhile ideas are being developed. And there in the USA, in contrast to the Soviet Union, a scientific idea is a good. Therefore, the development of a middleman-firm that knows the American laws and ethics of the market well is very important to us, so that the knowledge obtained in the USSR serves mankind and brings us hard currency.

It is clear why Soviet science is breaking into the world market. But obviously it is not that simple. The inconvertibility of the ruble creates many difficulties. One of the problems is paying for communication lines that are vital to the broad exchange of information. Our space science program may come to the aid of the Soviet scientists in this matter, since it is also trying to break into the world market.

A recent report on a national space symposium by the general director of the Applied Mechanics Scientific Production Association, academician M. Reshetnev, under whose direction almost all Soviet satellite communications and geodesical and navigational space systems were developed, was received in the USA with widespread interest. Together with the "Soyuzmedinform" Scientific Production Association and the Scientific Production Association for Fine Instruments of the company headed by M. Reshetnev, the Association of Small Satellite Manufacturers and Communications Services Representatives "Smolsat" was founded, to which foreign organizations now belong, and it is becoming international.

This communications system is based on low-orbiting satellites. In order to support global communication from any point on the planet, there need to be a lot of them—36. But they are small and inexpensive. One of the most inexpensive serial Soviet missiles "Cyclone" can simultaneously release six such satellites into orbit. This system, which is called "Gonets" (or "Messenger" in English) supports transmission of any kind of data in digital form: telex, text, speech, information exchange between data bases, and information collection from transmitters for monitoring the environment. This system's receiving devices on earth are also simple.

Naturally, one of the initiators for the development of the "Gonets" system was the "Soyuzmedinform" Scientific Production Association directed by A. Kiselev. The State Central Scientific Medical Library, which is part of this scientific production association, is one of the first in the country to make the change to "electronic rails." All of the fundamental studies of our physicians are entered into an electronic data bank and exchanged with the Federal Republic of Germany. On account of this the entire world community has access to our medical data base. It must be noted that the middleman firm "Science Information Express Data" and "Soyuzmedinform" are planning to use automated translation from Russian to English and vice versa. In principle, automated translation is also possible for any other pair of languages.

I also met representatives of the meeting's business circle, the directors of two English companies, at the Central Scientific Medicine Library. A space is sectioned off in one of the library's halls for the commercial information system "Hippocrat." Detailed information on all of the equipment and pharmacological resources offered by the companies for use in the Soviet market is stored in the computers' memory.

The foreign companies pay hard currency for entering their data into this system and receive in return a wide audience. The information is also offered to our clients on a commercial basis, but they pay in rubles.

"In spite of the difficult times, the Soviet market remains very enticing," says G. Yustas, head of the English firm "Cornix Systems." "For example, 3 billion dollars' worth of various equipment and medications were purchased from the Soviet Union in 1989. We are hoping that the development of the "Gonets" system will fundamentally supplement the "Hippocrat" system and make it global. The Soviet Union is the leader in the development of small satellite systems. There are now many firms chasing after you, but only your country is currently able to offer a system that is ready to use, and time in our rapidly changing world plays a colossal role."

As you see, our science and technology is breaking into the world market with full hands. We are hoping that we will still be able to get a place on the "world scientific and technological progress" express.



**Medical and Ecological Aerospace Surveillance Over Moscow and Leningrad**

917C0591A Moscow *TERAPEVTICHESKIY ARKHIV in Russian* Vol 63 No 4, Apr 91 90 (manuscript received 31 Oct 90) pp 116-124

[Article by A. G. Chuchalin, Yu. V. Novikov, P. P. Gorbenko, I. V. Vardiashvili, A. V. Dubinskaya, S. A. Ivanova, V. A. Kuliyeu, A. V. Leontyev and T. N. Novokshchenkova, Institute of Pulmonology, USSR Ministry of Health; Scientific Research Center of Cosmic Ecology; 'Aerazol' Medical Engineering Center for Prophylaxis of Respiratory Organ Diseases]

UDC 614.7(470.311-25)(470.23-25)

[Abstract] An analysis was conducted on the incidence of pediatric respiratory pathology in the Leningrad and Moscow regions in 1985-1989 for correlation with information on pollution levels in those areas gathered from aerospace surveillance by Resurs-01 satellite. The results showed a positive correlation between the levels of pollution and disposition of industrial sites on the one hand, and prevalent patterns of respiratory morbidity on the other. The findings confirmed the utility of aerospace telemetry in clinical pulmonology as a means of predicting health risks and providing guidance for preventive measures. Figures 6.

**Changes in the Behavior of Amphibians After Transplanting *Drosophila* Neural Stem Cells Into Their Brains**

917C0600A Moscow *DOKLADY AKADEMII NAUK SSSR in Russian* Vol 316 No 3, Jan 91 (manuscript received 20 Sep 90) pp 735-738

[Article by S. V. Savelyev, A. I. Ivanov, V. I. Gulimova, and L. I. Korochkin; Institute of Developmental Biology imeni N. K. Koltsov, USSR Academy of Sciences, Moscow; Scientific Research Institute of Human Morphology, USSR Academy of Medical Sciences, Moscow; presented by Academician G. P. Georgiyevyy 22 Aug 90]

UDC 591

[Abstract] This work was devoted to studying several behavioral reactions of amphibians after transplanting neural stem cells from *Drosophila* embryos into the amphibians' embryonic brains. To produce such neural chimeras, the authors used neurogenic stem tissue obtained in their laboratory from the new mutant *Notch Drosophila melanogaster*, and they injected fragments of this tissue into the nerve cord of *Xenopus laevis* embryos immediately after neural formation. Six months after the operation, the animals underwent metamorphosis and achieved masses of 4-6 g. The experimental animals developed faster than the control animals (all were from the same clutch of eggs), where the experimental animals underwent metamorphosis 10-11 days earlier and were 1-1.5 g heavier. Based on conducted experiments, the authors concluded that such transplants affected the behavior of frog recipients. These animals' overall

movement decreased, but their success in finding the exit from a maze increased. On the basis of recorded behavioral changes, one may propose that an accumulation of melanin surrounds the *Drosophila* nerve cells transplanted into the amphibians' brains since it is known that an increased melanin concentration is correlated with increased metabolic activity in the corresponding part of the embryo. The established dependence of amphibian behavioral changes on the transplantation of *Drosophila* neural stem tissue allows one to accept the feasibility of creating neural chimeras whose behavior can be directed by the corresponding *Drosophila* mutant used. Figures 3; references 6: 2 Russian, 4 Western.

**Soviet Production of Psychotropic Biogenerators**

917C0601A Moscow *KOMSOMOLSKAYA PRAVDA in Russian* 27 Aug 91 p 6

[Article by Viktor Sedletskiy, director and chief designing engineer at the "Forma" center of the USSR Association of Technologists and Engineers in the international consortium "Ekoprom", and vice-president of the USSR League of Independent Scientists. Reported by O. Musafirova, *KOMSOMOLSKAYA PRAVDA* correspondent: "Have the Creators of the "Zombie" Program Been Found in Kiev?" First paragraph is *KOMSOMOLSKAYA PRAVDA* introduction in italics.]

[Text] *Who would have thought that our investigation of modern methods of controlling the human mind would encounter a failed attempt at a government revolution?* (for the beginning see *KOMSOMOLSKAYA PRAVDA* issues dated 14 and 22 November, 12 and 30 December, 1990, and 19 and 25 January 1991).

As a specialist and juridical person, I can confirm that the serial production and testing of psychotropic biogenerators (which is most important) has begun in Kiev. I cannot confirm which specific Kievian generators were used during the coup. We need to know their technical descriptions for such a statement. However, the fact that they were used is clear to me.

What exactly are psychotropic biogenerators? They are electronic pieces of equipment which exert a controlling effect on the human body. In particular, the effect is on the left and right hemispheres of the cerebral cortex. The so-called "Zombie-5" project in the USA was based on this.

Similar studies are also being conducted in the Soviet Union (specifically, there are biogenerators which were manufactured at the "Oktav" factory at the Materiology Problems Institute, in one of the departments whose laboratory is located in the residential tracts of Kiev). Based on personal experience, I can say that I designed a model of such a generator. I finished my work in August 1990. Experiments were conducted on animals. We did not conduct any experiments on humans. However, it has recently been made known to me that such experiments are being performed on highly paid volunteers.

I officially informed Ye. K. Marchuk, the Ukrainian SSR State Minister for Defense, National Safety, and Emergencies, of my own opinions on this subject (psychotropic biogenerators, the reality and possible evil use of them) a month ago. However, I have not received any response.

Why did the system fail during the government revolution? The coup leaders, lacking experience, did not know that they could not let "treated" soldiers mix with the people on the street for this reaction.

### Glass Bottles With Modified Internal Surface

917C0623A Moscow STEKLO I KERAMIKA  
in Russian No 3, Mar 91 pp 7-8

[Article by Z. V. Zhitkevich and G. A. Logunkova, All-Union Scientific Research Institute of Medical Polymers]

UDC 666.172.7

[Abstract] Soviet glass bottles for storing blood and transfusion and infusion preparations are made from NS-2 glass and are not as resistant to chemical corrosion as their foreign counterparts. They do not meet CEMA and International Standardization Organization standards. A novel technique has been prepared for a simple and inexpensive method for the manufacture of glass packaging products that are very resistant to chemical corrosion. The internal surface of the glass bottles is modified by treatment with acidic gases (hydrogen chloride, sulfur di- and trioxide) which react with alkali metal ions at melting temperature to form a salt coating on the surface. These bottles for blood and transfusion and infusion preparations are recommended to the USSR Ministry of Health for large scale production. Since the bottles are made from alkali-silicate glass, the savings due to the use of the latter instead of boron-containing raw materials, refractory materials, and fuel will be 600,000 rubles per year. Figures 1; tables 1.

### Book Review: Clinical Pharmacology With International Nomenclature

917C0624A Moscow KLINICHESKAYA MEDITSINA  
in Russian Vol 69 No 1, Jan 91 (manuscript received 19 Mar 90) p 121

[L. L. Orlov review of book: Clinical Pharmacology With International Nomenclature by V. K. Lepakhin, Yu. B. Belousov, and V. S. Moiseyev, Izdatelstvo Universiteta Druzhby Narodov, Moscow, 1988, 444 pp.]

UDC 615.11(100)(049.32)

[Text] In 1988, the publication of a textbook for medical institute students, the authors of which are V. K. Lepakhin, Yu. V. Belousov, and V. S. Moiseyev, was an event in the medical life of the nation reaching far beyond student interests. This publication is a fundamental manual of great value to a wide range of practicing

physicians. There were no publications of this type in our country; therefore, the enormous interest in this manual is understood. The combined efforts of highly qualified specialists—pharmacologists and clinicians that interpret complex problems of the use of medicines at a modern level are of great use.

The textbook consists of two sections. This first section illustrates general questions of clinical pharmacology that are little known to students and practicing physicians. Of special interest to the reader are sections devoted to pharmacodynamics and pharmacokinetics. It cannot be doubted that a basic familiarity with the fundamental tenets expounded in this manual make possible the rational development of therapeutic strategy at the patient's bedside. Detailed study of this fundamental section of the manual will facilitate the development of pharmacological thinking, and consequently, overcoming banal symptomatic treatment.

The second section of the textbook is devoted to private clinical pharmacology. It is written on a high modern level. In a journal review it is unfortunately not possible to thoroughly dwell on the numerous achievements of the authors. In positively evaluating the chapters in the textbook devoted to the use of basic medicines in cardiovascular diseases, thromboses, rheumatic and autoimmune diseases, bronchial obstruction syndrome, infectious diseases, hematologic pathology, digestive organ diseases, and many other diseases, it should be noted that the authors preserved information on traditional means of managing diseases and made it possible to look toward the future of the use of novel medicines. The reader will find information on preparations that are still not well known to Soviet physicians but which hold a very strong place in modern pharmacotherapy in the textbook.

Of course, they could have increased the number of nosological versions examined, but even without this there is still a great deal of information in the book. Thus, in the sections devoted to managing cardiovascular system diseases (stenocardia, arterial hypertension, chronic congestive cardiac insufficiency—why not circulatory insufficiency?), the reader finds extensive information on the management of arrhythmia, thrombus complications, infectious diseases, etc.

It seems that there are some questions discussed in the textbook that may evoke an objection. For example, the suggestion to begin the treatment of arterial hypertension with the use of saluretics. Preparations of rauvolfia and guanethidine derivatives are not even mentioned in the very useful plan presented for the treatment of essential hypertension. Incidentally, they were earlier listed as preparations that reduce arterial pressure. It would be desirable, considering the increasing trend to use clonidine in all cases of hypertension, to also clearly formulate indications for its use. The recommendation for the use of furosemide in addition to cases that also involve encephalopathy is debatable.

Since there is not a special section devoted to therapy of myocardial infarct patients, the reader may get the impression that this treatment should be performed using the same medicines employed for eliminating stenocardia, arrhythmia, circulatory insufficiency, etc. However, the concept of the therapeutic possibility of limiting the area of the necrosis has recently been substantiated. It would clearly be useful to allocate a respective section in the book.

This textbook is a great achievement of this collective of authors. In conclusion it should be added that although a large number of copies were printed (75,000) even by current standards, considering the great demand for such a manual by the army of physicians and students which numbers approximately 1 million, it should quickly be re-published on the more powerful basis of "Meditsina" Izdatelstvo. ©COPYRIGHT: "Klinicheskaya meditsina", 1991

#### Laser Spectroscopy in Mycobacteria Identification

917C0662A Moscow VETERINARIYA in Russian No 2, Feb 91 pp 28-30

[Article by V. I. Okolelov, A. P. Tatarinov and Ye. S. Martynova, All-Union Scientific Research Institute of Animal Brucellosis and Tuberculosis, V. Z. Pashchenko, Moscow State University, and I. R. Nabiyeu, Institute of Bioorganic Chemistry, USSR Academy of Sciences]

UDC 619:543.424:6.6.982.2

[Abstract] UV Raman spectroscopy ( $\lambda_{exc} = 220-450$  nm) was tested for its application as a rapid diagnostic technique for the differentiation and identification of mycobacteria. The study was based on comparison of the spectral profiles obtained with Mycobacterium bovis, BCG, M. avium, M. smegmatis and M. phlei. Analysis of the spectral differences demonstrated that the bacteria in question readily fell into three groups: BCG, M. bovis and M. smegmatis, and M. avium and M. phlei. In addition, the spectra of the pathogenic strains M. bovis and M. avium were further characterized by a low frequency maximum for the guanine band (ca. 1330  $cm^{-1}$ ) in comparison with the nonpathogenic strains. These preliminary observations point to the potential utility of UV Raman spectroscopy in the arsenal of rapid diagnostic methods. Figures 5.

#### Mathematical Modeling of Red Nucleus

917C0674A Yerevan BIOLOGICHESKIY ZHURNAL ARMENII in Russian No 8, Aug 90 (manuscript received 25 Jun 90) pp 635-643

[Article by V. D. Barsegin, D. S. Melkonyan and V. V. Fanardzhyan, Institute of Physiology imeni L. A. Orbeli, Armenian SSR Academy of Sciences, Yerevan]

UDC 612.8.52.50

[Abstract] Electrophysiological data were analyzed to derive a dynamic model for the neural networks within the red nucleus. The model was formulated in terms of membrane and subsynaptic current time constants. Utilization of Rall's assumptions [Biophys. J., 2(1):145, 1962] led to the conclusion that the nature of synaptic transmission in the red nucleus—in response to a volley of afferent impulses from massive projections from the contralateral cerebellum and ipsilateral motor cortex—is determined largely by behavior of presynaptic endings, i.e., dynamic synaptic modulation. The latter ensures selective identification by the red nucleus of patterns of signals based on their temporal interrelationships. Figures 4; references 11: 3 Russian, 8 Western.

#### Modeling of Synaptic Modifications in Learning Neural Networks

917C0674B Yerevan BIOLOGICHESKIY ZHURNAL ARMENII in Russian No 8, Aug 90 (manuscript received 25 Jun 90) pp 649-652

[Article by O. A. Mkrtchyan and A. A. Melkonyan, Institute of Physiology imeni L. A. Orbeli, Armenian SSR Academy of Sciences, Yerevan]

UDC 612.8.52-50

[Abstract] Theoretical considerations are presented for an analysis of learning processes in neural networks, i.e., facilitation of synaptic transmission. Electrical findings were correlated with neurotransmitter release, local elevations in  $K^+$  concentrations, and spatial  $K^+$  buffering capacity in relation to the efficiency of signal transmission. The resultant data indicated that glial elements are key factors in interrupting feedback loops from the postsynaptic element to the presynaptic endings in trained networks. References 10: 5 Russian, 5 Western.

#### Increasing Information Capacity of Hopfield Neural Networks

917C0674C Yerevan BIOLOGICHESKIY ZHURNAL ARMENII in Russian No 8, Aug 90 (manuscript received 25 Jun 90) pp 657-660

[Article by V. G. Vagradyan, Institute of Physiology imeni L. A. Orbeli, Armenian SSR Academy of Sciences, Yerevan]

UDC 612.822.014:621.372.001.57

[Abstract] A theoretical analysis was conducted on enhancement of the information content of Hopfield-type neural networks. Although a definitive quantitative description of the putative process remains to be attained, the preliminary indications—using image processing models—are that the information capacity (M) of a Hopfield network is proportional to the ratio of the square of the number of neurons (N) to the number of neurons (K) already 'occupied' by images ( $M = 0.14 N/K$ ). References 4: 1 Russian, 3 Western.

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